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# FINAL REPORT on the 1952 BLOWDOWN AND BARK BEETLE SURVEY in the DOUGLAS-FIR REGION OF OREGON AND WASHINGTON

A COOPERATIVE PROJECT  
under the supervision of  
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION  
U. S. FOREST SERVICE  
and  
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE  
PORTLAND FOREST INSECT LABORATORY

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PORTLAND, OREGON  
JULY 1953

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## PARTICIPATION

The following participated directly in the field work for this survey and in disseminating the information from it:

Oregon State Board of Forestry

Industrial Forestry Association

Tree Farm Management Service

U. S. Forest Service, Region 6

U. S. Bureau of Land Management, Region 1

U. S. Weather Bureau

Division of Forest Insect Investigations,  
Bureau of Entomology and Plant Quarantine

Pacific Northwest Forest and Range Experiment  
Station, U. S. Forest Service



FINAL REPORT ON THE  
1952 BLOWDOWN - BARK BEETLE SURVEY IN THE  
DOUGLAS-FIR REGION OF OREGON AND WASHINGTON

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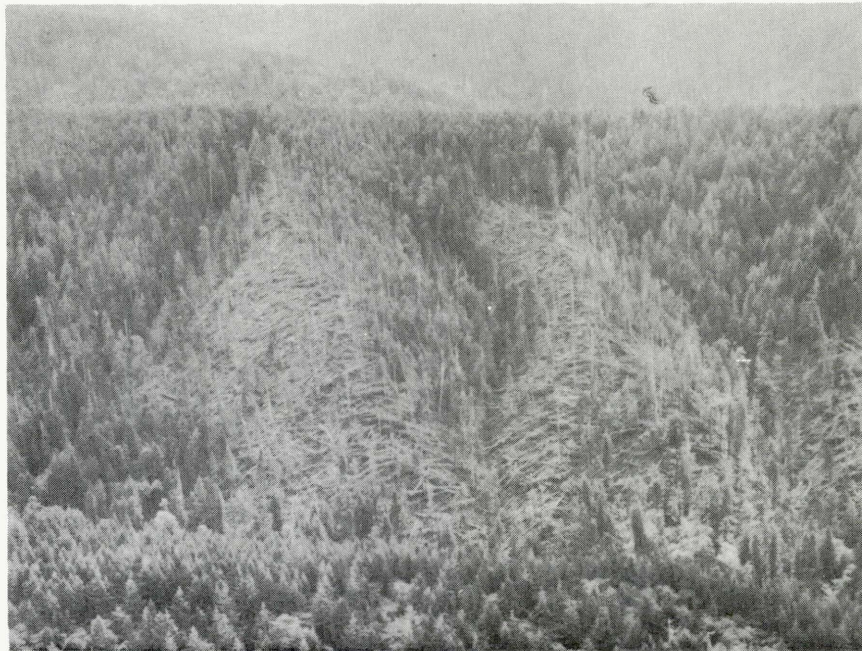
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Acknowledgment

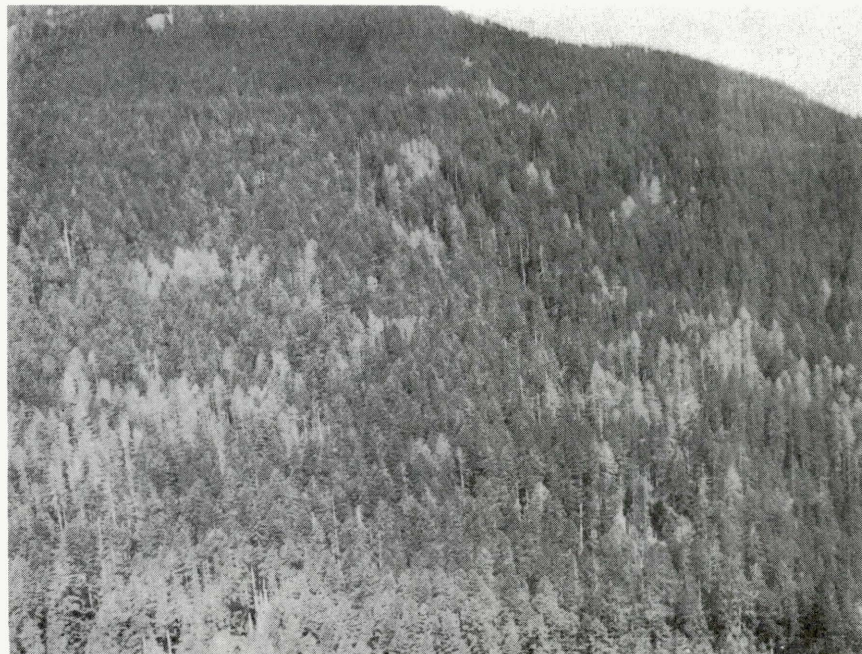
The authors wish to make special acknowledgment of the substantial contributions to this project by R. C. Wilson, a member of the staff of the Experiment Station until late July of 1952. Mr. Wilson was the project leader from the time the survey was conceived in mid spring of 1952 until July 24, when he was transferred to another emergency project. Much credit for the success of the project is due to Mr. Wilson's outstanding leadership and organization. If he had not been transferred, he undoubtedly would have been one of the authors of this report.

U. S. Department of Agriculture  
Portland, Oregon  
July 1953

PLATE I. DAMAGE BY BLOWDOWN AND DOUGLAS-FIR BARK BEETLE.



Heavy blowdown on leeward side of spur ridges, vicinity of Cape Creek, near Florence, Lane County, Oregon.



Groups of Douglas-fir trees killed by 1951 attacks of the Douglas-fir bark beetle, on the northeast face of Marys Peak, Benton County, Oregon.

(Frontispiece)



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## SUMMARY

Winter storms in recent years have caused widespread blowdown and snowbreak in the Douglas-fir timber stands of western Oregon and Washington. Particularly severe windstorms in the winter of 1951-52 contributed much of the blowdown. Associated with this damage there has developed an epidemic outbreak of the Douglas-fir beetle which is already the most serious outbreak of this beetle ever known.

Direct control of this epidemic is not possible. No known spray treatment provides a practical means of control. Salvage logging is the only feasible action that can be taken to effect a degree of control.

In order to secure information on the location and volume of the damaged timber, a special cooperative survey was made early in the summer of 1952. Crews of mappers flying in airplanes mapped blowdown and bark-beetle damage in place on one-inch-to-the-mile scale maps. The survey covered 11,500,000 acres intensively by systematic survey flights during July of 1952. Nearly 2,000,000 additional acres were covered in scouting flights. In funds directly appropriated or contributed for the project, the survey cost \$83,600, approximately 7/10ths of a cent per acre. Two private, one State, and six Federal agencies joined in planning and carrying out this project.

The survey found that the combined loss from the 1951-52 blowdown and 1951 attacks of the Douglas-fir beetle was approximately 10,000,000,000 board feet, log scale, net.

Detailed information on the location of damage areas was published in the form of one-inch-to-the-mile scale maps covering 89 quadrangles of western Oregon and adjacent Washington. Loggers and landowners have been advised of the need to carry on an aggressive salvage logging program. A "Summary Statement" on this survey was published in October, 1952.

The report that follows presents details on the way the survey was organized and carried out, a discussion of the findings and their significance, and a good deal of detail that would be helpful to any group concerned with organizing a similar survey for a similar purpose.



## BACKGROUND

### How the Beetle Epidemic Developed.

The present outbreak of the Douglas-fir beetle had its origin in the abnormal wind and snow damage of the winter of 1949-50. Damage was almost region-wide. The broken and windthrown trees provided ideal breeding conditions for the beetles in the spring of 1950. Great numbers of beetles that developed in this material during the season of 1950 emerged and attacked surrounding green timber in the spring of 1951. The evidence of killing by the beetles began to show up as "red-topped" trees in the fall of 1951, but due to the customary delay in fading of many of the killed trees, the damage could not be fully evaluated until the summer of 1952.

To make the situation worse another storm, one of the most damaging ever recorded in the Pacific Northwest, occurred on December 4, 1951 and blew down tremendous volumes of timber, particularly in the Coast Range of Oregon. With a large population of beetles on hand from the 1951-killed trees it was inevitable that the newly blown-down timber would be heavily attacked by beetles starting in the spring of 1952. Broods from the down trees emerged and made new attacks in the spring of 1953.

Two other factors added to the seriousness of the beetle problem. First, during 1951 a number of large forest fires left numerous killed or scorched trees in many parts of the region. And second, the growing seasons of 1951 and 1952 were among the driest ever recorded in the region. Past experience is that extensive areas of fire-killed timber often are important in generating epidemics of the Douglas-fir beetle. Following the Tillamook and Bandon fires many millions of feet of green timber adjacent to the burns were killed by beetles. The exact effects of drought on subsequent attack by the Douglas-fir beetle are unknown; however, there is no doubt that weakened trees are preferred over thrifty trees as host material.

It was obvious by the spring of 1952 that a very serious situation already existed, with additional large beetle broods expected to develop during the coming season in (1) trees that were windthrown in the winter of 1951-52, (2) trees that were fire-killed in late 1951, and (3) green timber adjacent to the 1951 infestation centers. Even barring added killing by wind, fire or drought, there was every reason to believe that the epidemic would continue for at least two years.

### Preliminary Surveys.

Two surveys of the beetle situation were made prior to the one described in this report. The first was an aerial detection survey



made in western Oregon during the fall of 1951 by the Oregon State Board of Forestry as part of the region-wide forest insect detection survey which is conducted cooperatively each season by the State and the Portland Forest Insect Laboratory. This was only a partial survey due to forest-fire smoke that limited observations. However, enough evidence of insect activity was seen to show that a serious epidemic was in progress. The second was a special reconnaissance survey made by the same two agencies in cooperation with the Weyerhaeuser Timber Company in the spring of 1952 to delineate the outbreak.

The second survey was aimed at defining the extent and relative severity of damage, in order that the seriousness of the situation could be brought to the attention of landowners, and that control through salvage logging could be initiated. The results of the survey were presented in a report and released through the Northwest Forest Pest Action Committee on April 28, 1952. (2) 1/ The survey revealed a total of 3,120,000 acres of epidemic infestation in Oregon and Washington, of which only 72,000 acres was in Washington. It was estimated that there was a net volume of some 108 billion board feet of Douglas-fir saw timber within the boundaries of the infested area, all of which could be considered as threatened by the beetles.

It was apparent from the preliminary surveys that severe damage had occurred in many areas. In view of the tremendous volume of fresh windthrow available to help bring about a rapid build-up of the bark beetles, some definite action was needed by all interested parties to effect as much control as possible. Spraying or other direct treatment did not offer a practicable means of control. Basic to any plans for control through salvage logging was more detailed information of the location and amount of the beetle kill and, even more important, the location and volume of windthrow. It was to fulfill this need that the blowdown-bark beetle survey described in this report was organized.

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1/ Numbers in parentheses refer to literature cited, p. 30.

## THE 1952 SURVEY

### The Need.

As of May, 1952, the following information concerning the damage was at hand:

1. There was an active beetle infestation scattered over more than 3,000,000 acres.
2. High winds that caused heavy blowdown on the Coast during December of 1951 had covered most of western Oregon. Abnormal blowdown over much of this area seemed probable.
3. In order for salvage logging to have the most effect in controlling the infestation, the greatest possible volume of current blowdown, currently infested trees, and timber killed in 1951 fires should be removed from the woods before the spring of 1953.

In view of this knowledge the following action was needed:

1. Determine the location and extent of the catastrophic blowdown of the winter of 1951-52, and the timber killed by beetles in 1951.
2. Get detailed information on the above points to landowners and loggers by early fall of 1952.
3. Obtain additional and more detailed information on the status of the beetle infestation and the volume of timber affected to date.

### Survey Objectives.

The objectives of the survey to get the needed information were as follows:

1. To define the area within the Douglas-fir region affected by the severe windstorms of the winter of 1951-52.
2. Within that area to provide an estimate of the total volume of timber blown down during the winter of 1951-52, as well as an approximation of volumes blown down during the preceding two winters.
3. Also within that area to provide an estimate of the volume of Douglas-fir timber killed by the Douglas-fir beetle in 1951.



4. To provide in map form for use by landowners and loggers reasonably detailed information on the location of significant amounts of blowdown and beetle kill.

#### The General Survey Plan.

The most practical way to obtain the needed information in the short time that was available was to make a survey from the air. After study and consideration, it was decided that it would not be feasible to use aerial photographs since the cost would be prohibitive and it would not be possible to get the large area photographed and the prints interpreted in time. Furthermore, there was serious question if the damage could be evaluated from aerial photographs. Instead, it was decided that the survey should be based on an aerial sketch-mapping technique which had been used for the previous five years by the Portland Forest Insect Laboratory in their regular insect detection surveys. It was also decided that the work would have to be done on a sufficiently intensive scale so that maps showing damaged areas could be published on a scale of one inch to the mile. It was apparent, too, that a scheme would have to be devised to permit coordination of aerial mapping with ground cruising so that sample plots cruised on the ground could provide an acceptable basis for volume estimates.

After a general plan had been developed, the first necessary step was to test two basic assumptions on which the plan rested. These assumptions were: (1) That significantly different intensities of blowdown could be recognized from the air and mapped in place by flying mappers making a single flight over an area; and (2) that beetle-kill groups of varying size could likewise be mapped in place as a result of a single flight over an area. A technique development study was made during May to check these two assumptions and to further refine the techniques of aerial mapping. When this study showed that the contemplated methods were feasible, funds were requested for the full survey, plans for conducting the job were completed, and the mobilization of needed manpower and equipment was started.

#### Participation.

Many groups had a hand in the completion of this survey. The project was strongly encouraged, and the results given wide publicity, by the Northwest Forest Pest Action Committee. Personnel were made available by the Oregon State Board of Forestry; Tree Farm Management Service; U. S. Forest Service, Region 6; U. S. Bureau of Land Management, Region 1; the Portland Forest Insect Laboratory of the U. S. Bureau of Entomology and Plant Quarantine; and the Pacific Northwest Forest and Range Experiment Station, U. S. Forest Service. Substantial services were provided by The Industrial Forestry Association and the U. S. Weather Bureau. Details on the contributions provided by each are given in the Appendix.

Direction and supervision of the survey were handled as follows: The Portland Forest Insect Laboratory of the Bureau of Entomology and Plant Quarantine had responsibility for technical advice and shared responsibility with the Experiment Station for planning and supervision. The Division of Forest Economics, Pacific Northwest Forest and Range Experiment Station, carried the Station's responsibility for planning and supervision. This Division had over-all responsibility for leadership.

#### Area Surveyed and Cost.

A total of approximately 13,500,000 acres was surveyed from the air. Of this area about 11,500,000 acres were covered in planned mapping flights (see map 1 in the Appendix) and about 2,000,000 acres in scouting flights. A total of about 10,500,000 acres had enough damage to warrant publishing detailed maps showing the location of the wind-throw and beetle kill. The area covered by this survey contains the bulk of the remaining virgin Douglas-fir timber in western Oregon and a considerable portion of that in southwest Washington.

The funds came from three sources. A total of \$62,700.00 was allotted by the U. S. Forest Service from funds appropriated under the Federal Forest Pest Control Act. An amount of \$10,000.00 was contributed outright by the Oregon State Board of Forestry. An estimated \$10,900.00 was contributed in personnel and services by various ones of the agencies that participated in the project.

The survey cost a total of \$83,600.00, including contributions in personnel and services. This represents a total cost of \$0.0072 per acre for the area covered by planned mapping flights. Additional details on costs will be found in tables 6 to 10 on pages A-6 to A-10 in the Appendix.



## SURVEY OPERATIONS

### Technique Development.

Before a full-scale survey could be undertaken, it was necessary to be sure that the proposed techniques would work. Consequently the first step was a special study to determine the feasibility of using the sketch-mapping procedure employed by the Portland Forest Insect Laboratory since 1947 for recording insect damage. It was also necessary to develop additional procedures, since extensive mapping of windthrow damage had not previously been done and a more detailed evaluation of beetle damage was needed than any that had previously been obtained. The two experiments to develop these techniques were carried out in May and early June and are described below.

The first experiment was set up to test the feasibility of making 100-percent counts of beetle-killed trees and mapping them in place from the air. The experiment was carried out near Sutherlin, Oregon, and essentially consisted of making a direct comparison of aerial and ground counts of trees killed by the Douglas-fir beetle. Nine plots, varying in size from 60 to 200 acres were laid out and the beetle-killed trees mapped in place and counted from the air by 5 observers, 3 of whom were totally inexperienced in aerial observing. The plots were subsequently ground-cruised and an actual count of the killed trees made. Results of the survey disclosed that accuracy in numbers of trees counted ranged from 80 to 95 percent, with an average for all observers of approximately 85 percent. Placement of the killed trees on maps made from the air was generally within 5 chains of the true ground position, but varied with the experience of the observers. (3)

The second experiment was largely designed to determine: (1) The ability of aerial observers to recognize and delineate areas of various intensities of windthrow from the air; (2) whether a contour or grid-iron type of coverage was best suited for this kind of mapping; (3) the intensity of coverage needed; and (4) the optimum height of flight and air speed for this kind of aerial mapping. The tests were carried out on an area of some 15,000 acres near Prairie Mountain northwest of Eugene, Oregon, with a pilot and three mappers making the observations. It was immediately obvious that for more than one man to be mapping from a plane at one time it was necessary that predetermined flight lines be followed and, where topography permitted, that these lines follow cardinal directions at regularly spaced intervals of not more than one mile. It was also apparent that the best crew organization for the type of aircraft used consisted of a pilot and three observers. A further conclusion was that 800 to 1,000 feet above the terrain was the best height of flight for optimum perspective of amount and extent of the blowdown. It was also found that morning and afternoon shadows limited the time of day when accurate mapping could be done to the period between about 9:30 a.m. and 3:30 p.m.

As a final check, a number of patches of blowdown were mapped in place. These were subsequently ground checked to learn the accuracy of the mapping and the ability of the observers to classify intensities of blowdown. Although complete agreement of ground and air mapping was not achieved, it was felt that the technique was usable, and that accuracy would improve with added experience and training on the part of the observers.

In the testing and in the subsequent flying, the airplane used was the Cessna 170-B. It is a four-place, single-engine, high-wing monoplane. This plane was selected because it can fly safely at speeds as low as 60 miles per hour, has sufficient power for quick climbs, provides excellent visibility, and has flying characteristics that make it a safe and reliable plane for this sort of work.

#### Project Organization.

As soon as it was known that a workable survey technique was available, development of the project organization was begun. The immediate needs were: (1) A detailed plan which would incorporate operating instructions with the essentials of the techniques that had been worked out; (2) a list of personnel needs together with an analysis of the recruiting problem involved in getting them on the job; (3) procurement of major pieces of equipment, the most important of which were the four aircraft to be used; and (4) two dozen copies of one-inch-to-the-mile scale maps covering every forested acre in the 13,500,000 to be covered, with the predetermined flight lines printed on them.

The first need was met by the preparation of a detailed Operations Manual which was completed June 24, 1952. (1) This manual covered project organization, detailed procedure and instructions on the flying, procedure to be followed on ground cruising, and an organization chart and work-flow chart. Copies of these two charts are shown on pages 8A and 8B of this report.

The procuring of project personnel presented some acute difficulties. There was not sufficient time to find enough qualified men who were not otherwise employed. Recruitment became largely a matter of finding already employed people who could do the work and who could somehow be spared from their regular jobs long enough to do this survey. Between June 9, when funds were allotted for this project, and July 2, when the first operational flight was made, 32 of the 36 people used had been recruited, with all of them either on the job or arrangements made for them to report.

A list of the personnel who worked on the project, showing the positions they held and the agency from which they came, will be found on pages A-15 and A-16 in the Appendix.

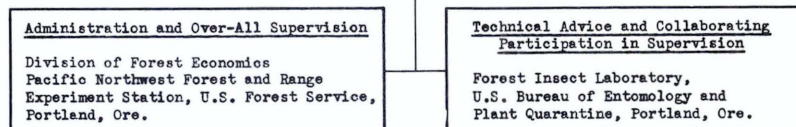


Figure 1.

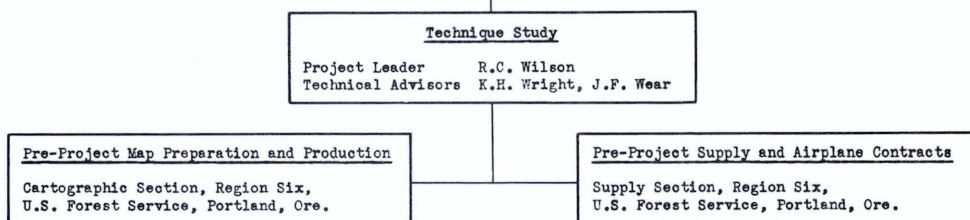
BLOWDOWN AND BARK BEETLE SURVEY

ORGANIZATION CHART

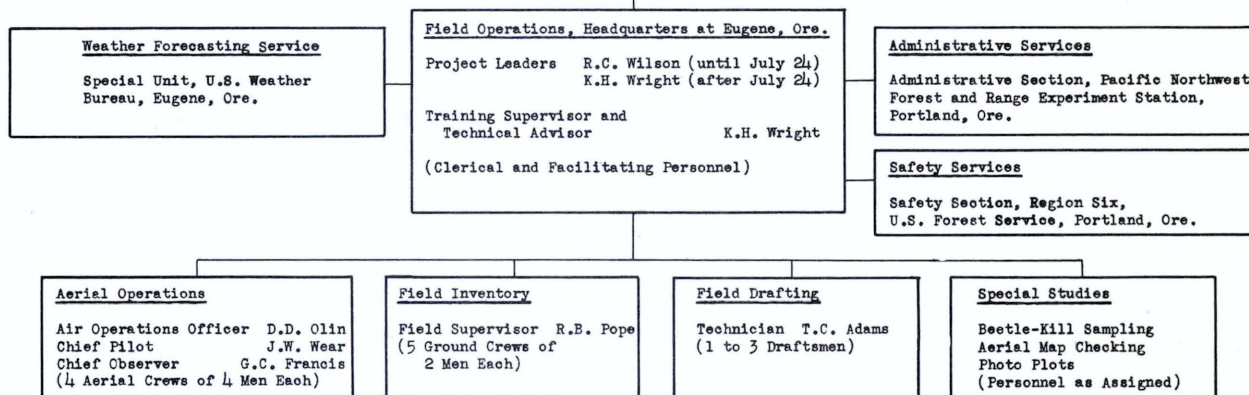
JOINT PLANNING AND SUPERVISION



PHASE ONE: MAY 12 TO JUNE 23



PHASE TWO: JUNE 24 TO AUG. 20



PHASE THREE: AUG. 21 TO NOV. 1

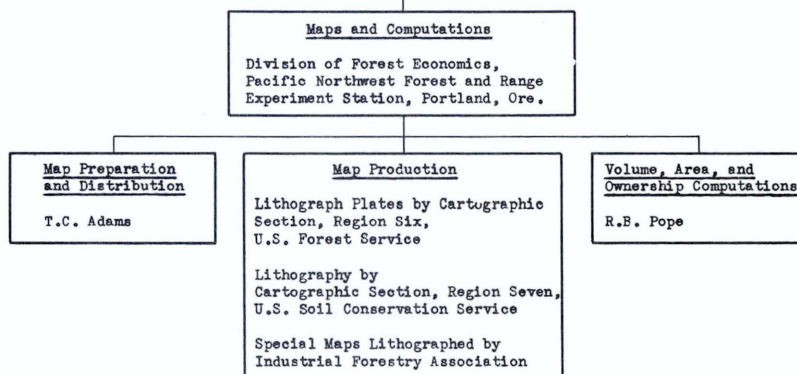
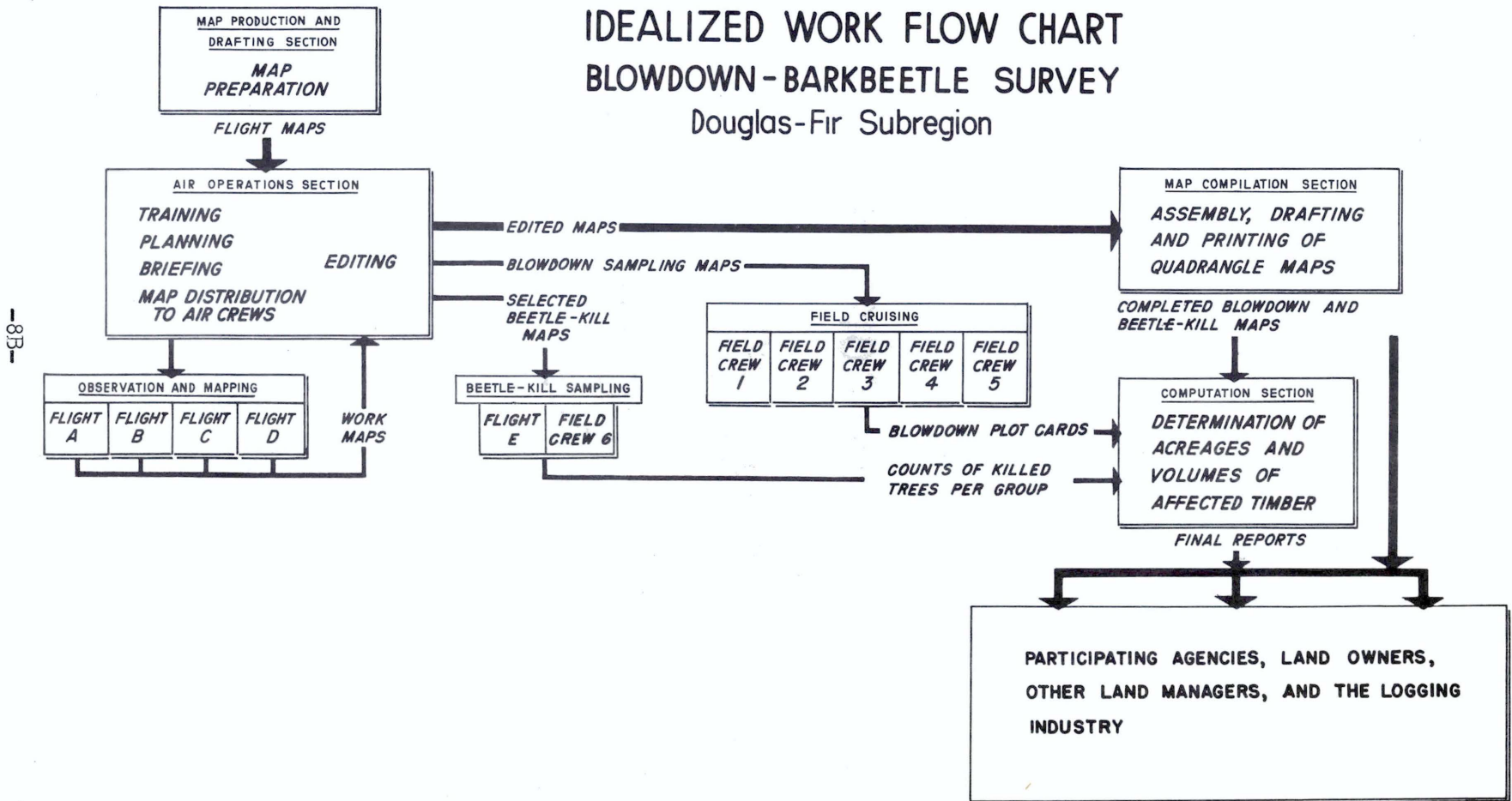


Figure 2.

# IDEALIZED WORK FLOW CHART BLOWDOWN - BARKBEETLE SURVEY Douglas-Fir Subregion



Procuring and reproducing the number of maps needed proved to be a very large task. Enough were needed so that each crew member had his own maps for each day's work. Good maps were available for only part of the 11,500,000 acres to be covered by mapping flights. For the rest, maps were obtained from whatever was the best source and included some new mapping. These were adjusted to the scale desired, and patched together to make composite quadrangle maps of 15 minutes each (approximately 220 square miles or 140,000 acres). This was the basic map unit. The map preparation work was very ably done by the Cartographic Section of the Region 6 office of the U. S. Forest Service, with much of the flight-line planning done by a former flyer in the employ of the Bureau of Land Management.

A great deal of thought and planning went into the preparations for the aerial phase of this job. Each aerial observer had a minimum of 12 hours of training in the air before his first operational flight. Training time with the pilots varied, depending upon the rapidity with which each man learned what he must do. An Air Operations Section, under an Air Operations Officer, was set up to organize and direct all flights from the main base at Eugene. In addition to the Air Operations Officer, a Chief Pilot and a Chief Observer scheduled the flights and coordinated the various phases of the work. A technical advisor was responsible for personnel training and the survey techniques used. Mapping assignments for the four aerial crews were made on a day-to-day basis so that the crews could be dispatched to those portions of the project area with suitable weather for mapping. Safety and radio communications were operated by the Air Operations Section. These aspects of the survey are discussed in more detail in the appendix section entitled "Administration."

An important part of the aerial phase of the project was the special weather forecasting and reporting service set up by the U. S. Weather Bureau. A Bureau official was assigned to set up the service, and an experienced man was detailed from Seattle to do the forecasting. This service provided detailed weather information from any part of the project area and was invaluable in the daily scheduling of mapping flights.

Project field headquarters were set up at Eugene, Oregon, on June 24, and were kept there until August 20 when the last of the flying was completed. All aerial operations centered at the field at Eugene. It was also the base of operations for field crews doing ground sampling work.

The aerial phase of the job was the spectacular part of the survey; but without the ground cruising, it would have told only half the story. Some unique sampling problems had to be worked out in setting up the cruising work to be done. Because the heavy pressure was to get the aerial work started, ground work did not get under way until



July 7. By September 19 the 214 plots in the Coast Range and the 47 plots in the Cascades had been established and tallied. Headquarters for this work were returned to Portland at the time the Eugene base was discontinued.

The race to get the maps published began in late July. Fifteen-minute quadrangle sheets were also the map unit for the published maps. It proved necessary to redraft some of the older portions of the quadrangles that had been patched together, and to do a great deal of editing to be certain that all of the information from the field maps was transferred to the final drafts in correlated form. A sample of the final published map, reduced in scale for publishing in this report, will be found on page 15. Of a total of 110 quadrangles that were mapped, in whole or in part, from the air, 89 were found to contain sufficient information on blowdown and beetle damage to justify publishing them. The final lithographing of the maps, both gray base and red overprint, was very efficiently done by the Cartographic Section of the Portland Regional Office of the Soil Conservation Service. Negatives for the multilith plates were made by the Forest Service Cartographic Section. The maps were completed and made available for public use and distribution in October. The Northwest Forest Pest Action Committee and the Industrial Forestry Association took an active part in giving these maps wide publicity and in acquainting forest landowners with information about them. Actual mailing was done by the Experiment Station.

#### Aerial Mapping.

The mapping procedure used on the project varied between the Coast and Cascades due to differences in topography and intensity of survey made in the two areas. In the Coast Range a 4-man crew, consisting of pilot, one insect mapper and two blowdown mappers, flew predetermined parallel flight lines one mile apart and at approximately 1,000 feet above the terrain. The two windthrow mappers sat in the rear of the plane and sketch-mapped the blowdown for a distance of 1/2 mile on each side. The insect mapper sat beside the pilot and mapped the groups of beetle-killed trees over the entire one-mile strip.

The mapping and navigating was done on one-inch-to-the-mile topographic or planimetric 15-minute quadrangle maps that were attached to 15" x 17" aluminum map boards. Identical copies of maps with the numbered flight lines printed on them were used by all members of the crew. These proved indispensable in permitting the pilot and mappers to keep oriented. The flight lines ran north and south, beginning and ending at the best topographic features available, and varied from about 12 to 15 miles in length. One full quadrangle map of timbered area comprised approximately a day's work for one crew.

In the Cascade area where complete mapping of the beetle damage was done but only a 12-1/2 percent sample was taken for the windthrow, and where the terrain is deeply dissected by major drainages, a different flight pattern and different mapping procedures were necessary. In this area flight lines were laid out in contour fashion about two miles apart, and were designed to cover major drainages in such a way as to avoid rapid changes in elevation or sudden large variations in height above the terrain. Two observers mapped the groups of beetle-killed timber for a distance of one mile each side of the airplane, while the third observer mapped the blowdown, on a sample basis, for one-fourth mile on one side. Again, by following the predetermined flight lines, orientation along the course was relatively easy for the observers.

A supplemental phase of the aerial mapping was the selection from the air, of blowdown areas to be subsequently ground sampled. The areas were selected randomly at the end of each day's regular mapping and in accordance with a prescribed procedure. Details on this procedure are given in the next section.

#### Ground Cruising.

In order to provide an estimate of the blowdown volume, sample plots were measured in the field in four classes of blowdown. Three of these classes were mapped from the air; the fourth consisted of light, unmapped blowdown in the remaining saw timber within the surveyed area. The purpose of this last class was to measure the amount of blowdown in scattered trees and small patches not identifiable from the air and hence not mapped. The first three of these classes of blowdown can briefly be defined as: (1) "heavy," 25 percent or more of the uncut stand windthrown; (2) "moderate," 10 to 25 percent of the uncut stand windthrown; and (3) "cut-over," 25 percent or more of the residual stand in a cut-over area windthrown.

Plot locations were determined as follows: Before the aerial mapping began, an estimate was made of the total number of plots that should be measured in each of the four classes of blowdown, separately for the Coast and Cascade areas. After the aerial mapping had been under way a few days, it was possible to calculate the percent of mapped blowdown patches that should be ground-cruised in order to have the desired total number of plots by the end of the project. The first calculation was a preliminary one. The percentage figures were less tentative as more area was mapped. At the end of a day's operational mapping, but while still over the area, the air crews counted the number of blowdown patches of the three intensity classes they had mapped during the day and by using the calculated percentage figure could determine the number of samples needed to fulfill the ground cruising requirements.



The next step was for the air crews to fly back over the area they had mapped and in accordance with a set procedure to mark on their maps the location of the required number of field samples in each blowdown class. In addition, the air crews chose a number of alternate locations. All selected areas were chosen randomly from those meeting the following two requirements: (1) reasonable accessibility and (2) so situated in relation to topography or other landmarks that the mapper could feel reasonably sure the area was accurately located. Any nearby roads not shown on the maps were added by the aerial mappers to aid location by the field crews. In addition, the position of the selected areas was closely checked and corrected in those cases where the location mapped earlier in the day was not accurate. These added assignments for the aerial mappers were designed to aid the field crews in getting to the sample areas.

Maps showing the locations of the selected sample areas were turned over to the field crews. Their first job was to get to the location marked on the map and decide whether or not they were in the blowdown area mapped by the air crews. If so, a field plot was taken; if not, the field crew spent only a reasonable amount of time looking for the mapped blowdown area. In cases where the mapped roads were impassable or the blowdown area could not be found after a reasonable search, the field crews moved to one of the designated alternate areas. Map 4 in the Appendix shows the location of the ground-sampling plots that were taken.

Having satisfied themselves that they were in the mapped blowdown area, the field crew then laid out a plot and measured the blowdown on it. Plots of different size and shape were used in each of the four classes of blowdown sampled. The plots in the heavy blowdown sample were one acre in area--one chain by 10 chains. The moderate blowdown plots were two acres in area--one chain by 20 chains, horseshoe-shaped. Plots for the scattered blowdown sample were three acres in area--one chain by 30 chains, also horseshoe-shaped. Cut-over sample plots were 1/2-acre in area--one chain by five chains.

Field crews consisted of two men, a compassman and a cruiser. The compassman established the direction of the plot center line and acted as head chainman and tallyman. The cruiser acted as rear chainman, made slope corrections, established the width of the plot and determined such tally information as age of blowdown, species, size and merchantability. The cruiser relied frequently on ocular estimates with sufficient measurements to insure consistent results.

The primary objective of the blowdown field work was to determine the amount of 1951-52 blowdown of Douglas-fir. However, in order to fill out the salvage picture in accordance with the over-all objectives of the survey, additional information was gathered on the field plots. All commercial species were tallied by four-inch d.b.h. groups on these classes of material: (1) All green trees blown down in the last year



(summer '51 to summer '52); (2) all green trees blown down the two previous years (summer '49 to summer '51); (3) all standing Douglas-fir trees beetle-killed within the last year; (4) all other salvable dead trees, standing or down (25 percent or more merchantable).

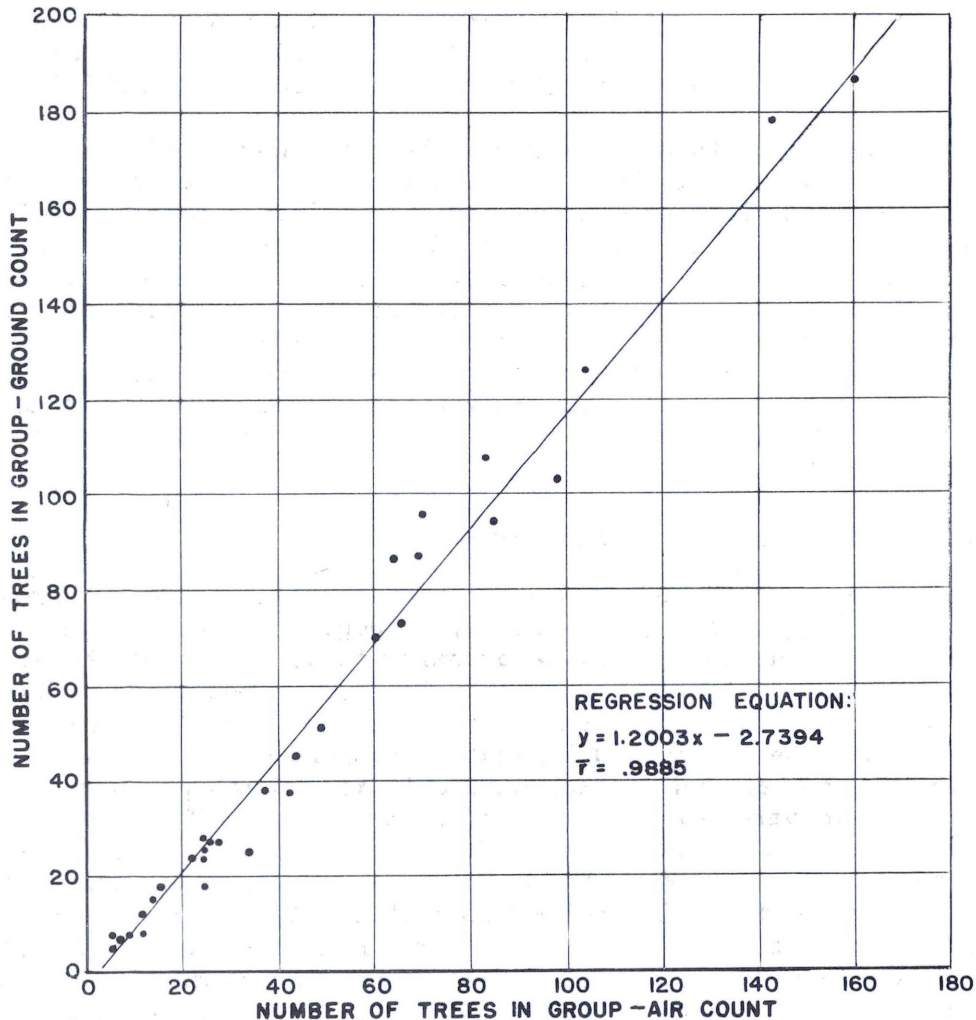
Within each of these classes sample trees were selected at systematic intervals. For these trees additional information was obtained on merchantable height and merchantability. After completion of the field work the sample trees were used to construct local volume tables in terms of volume over d.b.h. class. Volumes from the tables were then assigned to the trees on the plots which were tallied merely by species and d.b.h. class. From the plots, average-per-acre volumes were computed for each of the four classes of dead trees. Only the salvage material from class (1) above is summarized in this report. Class (2), (3) and (4) material has value from the resource survey drain standpoint.

#### Computations and Other Special Jobs.

The phases of this survey other than aerial mapping and ground cruising will be covered only briefly. Computing the area and volume figures turned out to be a time-consuming task, especially because the work had to be frequently interrupted to fill requests for special statistical information by land managers beginning salvage programs. Data on damage were compiled separately by land ownership class and by county. The various classes of beetle kill as mapped were reduced to a common denominator of number of trees killed. Then the volume of the average-sized beetle-killed tree in each county in the Coast area and for all the surveyed portion of the Cascade area was calculated. From this information, the volume of beetle kill by ownership class and by county was estimated. The damage from blowdown was taken directly from the field plot cards and carried through an appropriate blow-up procedure for the number of acres, by county and ownership, in each blowdown intensity class.

In order to be able to convert groups of beetle-killed trees to number of trees, a special study was conducted at the close of the aerial mapping phase. A pilot and the Chief Observer spent about a week making special flights to count from the air the number of trees in beetle-killed groups. The 220 groups counted were randomly selected and covered the full range of the number of trees per group encountered in the survey. Meanwhile two men were visiting some of these groups of beetle-killed trees on the ground and counting the number of killed trees in each group. From the two sets of data a regression was calculated and an average number of trees determined for the two size groups that had been differentiated in the mapping. The regression relationship between the aerial and ground counts of 33 representative groups of beetle-killed trees is shown in figure 3 which follows.

**Figure 3.**  
RELATION OF AIR AND GROUND COUNTS  
OF GROUPS OF BEETLE-KILLED TREES



It proved possible to make several checks on the calculations of beetle-killed volume. The Weyerhaeuser Timber Company made available the results of a detailed survey on two of their large holdings. Also, there were two strips of color aerial photographs, each covering an area five miles by one mile, taken as part of a research study. The numbers of beetle-killed trees shown by these sources were compared with a count on the reconnaissance maps of the same areas. The reconnaissance maps were low by almost exactly the same amount in each case. This occurred because some groups of beetle-killed trees were missed by the aerial mappers and a large number of small groups and individual trees were below the mapping standards. As a result of these comparisons, a calculated volume adjustment was applied to the beetle-kill volumes for the whole project. These adjusted figures are shown in tables 2, 3, and 5 on pages A2, A3, and A5, and are discussed in some detail in the section on "Findings."



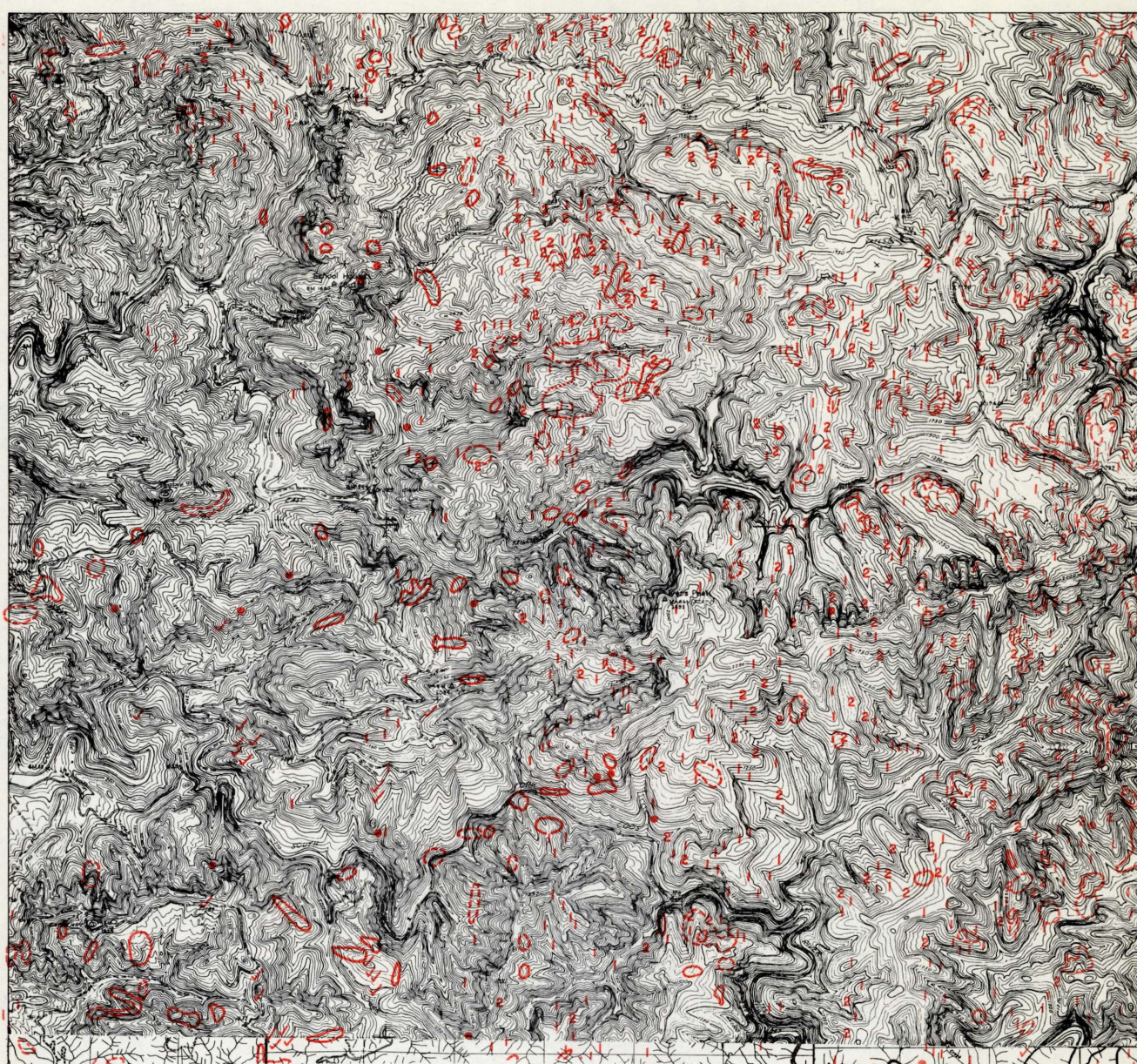


Figure 4.  
EXAMPLE OF QUADRANGLE MAPS  
PRINTED FOR DISTRIBUTION TO LANDOWNERS  
UNDERTAKING SALVAGE OF BLOWDOWN AND  
BEETLE-KILLED TIMBER

LEGEND FOR RED OVERPRINT

(SHOWN IN RED)

BLOWDOWN INFORMATION



Over 10 acres of heavy blowdown in uncut timber  
(25% or more of stand is recent blowdown)



5 to 10 acres of heavy blowdown in uncut timber



Over 10 acres of moderate blowdown in uncut timber  
(10 to 25% of stand is recent blowdown)



Heavy blowdown in cutover stands or in  
seed blocks of less than 40 acres  
(Each ✓ represents approximately 10 acres)

(SHOWN IN RED)

BEETLE-KILL INFORMATION

2

Heavy - Individual groups of 31 or more dead trees

1

Moderate - Individual groups of 6 to 30 dead trees

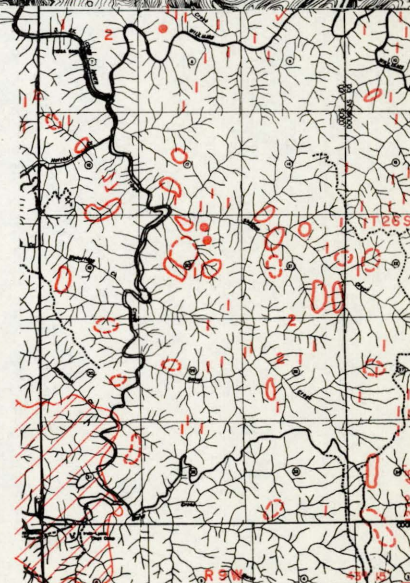


Light - General area containing at least one group  
of 2 to 5 dead trees per 40 acres



FIRE-KILL INFORMATION

Area burned in 1951 timber fires of more than 500 acres



0 1 2 3  
Scale in Miles



## THE FINDINGS

The survey showed that the combined loss from the blowdown of the winter of '51-'52 and 1951 attacks of the Douglas-fir beetle was just under ten billion board feet. In the recorded history of the forests of the two States, only the Tillamook Fire of 1933 has caused more damage at a single stroke. If the beetle infestation runs a normal course with no substantial reduction of population because of natural control or salvage logging additional heavy mortality caused by the beetle will occur.

Since the time of the survey in July of 1952, additional killing has shown up outside of the surveyed area in a number of locations in the Cascade Mountains in western Washington as far north as Mount Rainier. This loss is not included in the following figures nor in the tables and maps in the Appendix. Losses in the area covered by this survey to mid summer of 1952 are summarized in the following table. Full details are shown in tables 1, 2, and 3 on pages A1, A2 and A3 in the Appendix.

Locality	Area of concentrated blowdown <u>Acres</u>	Net volume losses 1/			
		Concentrated blowdown	Light blowdown	Beetle kill	Total
		<u>Million board feet, log scale</u>			
Coast Range	127,019	1,104.9	2,644.4	454.8	4,204.1
Cascades	74,781	378.3	4,752.3	550.2	5,680.8
Total	201,800	1,483.2	7,396.7	1,005.0	9,884.9

1/ Estimated sampling error: Coast Range 13 percent, Cascades 28 percent, total 17 percent.

The concentrated blowdown in the above table consists of the classes that have been referred to earlier in this report as "heavy," "moderate," and "cut-over." These are the classes of blowdown that were mapped from the air. The volume loss of 1,483.2 million board feet is located on the 201,800 acres of concentrated blowdown. The light blowdown class includes the blowdown on the rest of the saw-timber bearing acres in the surveyed area, a total of 6,076,000 acres.

### Blowdown.

Two distinct types of blowdown were encountered, each presenting special problems from the standpoint of both salvage and potential for increase of the beetle population. One was the type that occurred in concentrated patches, often covering five acres or more and extending in a few exceptional cases to swaths 1-3/4 miles in length and averaging nearly a quarter of a mile in width. The other type was the blowdown that occurred as scattered individual trees and small groups of trees over extensive areas.

Most of the concentrated blowdown resulting from the winter's storms of '51-'52 was in the Coast Range of Oregon. Much of this came from a single storm--on December 4, 1951. Map 2, in the Appendix, shows the relatively greater occurrence of concentrated blowdown on the Coast. Had the Cascade area been sampled on the 100-percent basis that was employed on the Coast, the generalization shown in map 2 would indicate somewhat more blowdown in the Cascades. Even so, the Cascade area had substantially less area in patches of concentrated blowdown.

By contrast, the scattered type of blowdown, which is not shown on map 2, was greater in volume in the Cascades than it was on the Coast. No doubt a very large number of ground samples would have shown some pattern in the occurrence of the light blowdown. In the absence of a large number of such samples, it was assumed in calculating these volumes that the light blowdown occurred uniformly in the saw-timber area of the Coast Range and of the Cascade area. This assumption is supported by the fact that light blowdown was encountered on most of the ground sample plots.

It should be noted here that the very widespread nature of the light blowdown was not adequately anticipated when the field portion of this survey was designed. At the time the ground sampling work was being planned, it was assumed that there would be more scattered blowdown in the Coast area than in the Cascade area. As a result the sampling error for this class of blowdown in the Cascade area is much larger than is desirable.

For the Coast area, the average net blowdown volume per acre was 18,000 board feet for the "heavy" class, 5,100 for the "moderate" class, and 1,000 for the "light." In the Cascade area, the "light" class was 1,400 board feet. For the Coast area, the percent of the stand blown down in the various intensity classes was "heavy," 43 percent; "moderate," 16 percent; and "light," 5 percent. For the Cascades, comparable figures are: "heavy," 28 percent; "moderate," 16 percent; and "light," 5 percent.

#### Beetle Kill.

The general pattern of beetle kill, as shown on map 3, represents the status of visible mortality as of July 1952. The areas of heavy concentration are much the same as were shown by the reconnaissance survey made in the spring of 1952 (2). In Oregon major drainages where sizeable percentages of the stand have been killed are the Middle Fork of the Willamette, Mosby Creek and Upper Smith River in Lane County; the north and south forks of the Umpqua River, Cow Creek, Olalla Creek, Upper Williams River, Fall Creek, Bottom Creek and Lake Creek in Douglas County; the South Fork of the Coos River and the East and Main Forks of the Millicoma River in Coos County; and the Mary's Peak Watershed in Benton County.

The outbreak in Washington is principally in Skamania, Klickitat and Lewis counties in Washington. Areas of heaviest infestation are on the Gifford Pinchot National Forest in the Little White Salmon River, Panther Creek and Upper Cowlitz River drainages.



PLATE II. EXAMPLES OF HEAVY BLOWDOWN.



Blowdown in a patch of uncut timber adjacent to a clear-cut area, about ten miles from Monroe, Lane County, Oregon. This timber has been bucked as a first step in salvage logging.



Heavy blowdown near the Pacific coast, vicinity of Cape Creek, eleven miles north of Florence, Lane County, Oregon.



PLATE III. AERIAL VIEWS OF HEAVY BLOWDOWN.



Strip of heavy blowdown on a ridge above a cutting area near the head of Fish Creek, Lane County, Oregon.



Heavy blowdown near San Antonio Creek, Lane County, Oregon.



Between and beyond these heavy intensity areas, the infestation is well established. The Douglas-fir stands of Coos, Douglas, Jackson and Lane Counties have already experienced heavy damage by the beetles. The 1952 and 1953 attacks by the beetles will doubtless result in additional significant volumes of killed timber.

#### Damage by Ownerships.

As might be expected, all classes of land ownership present in the area have suffered blowdown and beetle damage. The ownership pattern is a particularly complex one. For this reason, no effort has been made to make an analysis of the damage by individual private holdings. In fact, the data on volume of damage were not obtained in such a way as to permit doing so. An analysis was made of the amount of damage by classes of ownership for the principal classes present. These findings are summarized below. More details are presented in tables 4 and 5, pages A-4 and A-5 of the Appendix.

Damage by Class of Ownership				
Class of ownership	Area of concentrated blowdown	Type of damage		
		Volume of total blowdown	Volume of beetle kill	Total volume
	<u>Acres</u>	<u>Million board feet, net, log scale</u>		
State of Oregon <u>1/</u>	4,195	126.1	9.5	135.6
Lands administered by Bureau of Land Mgmt.	44,375	1,447.3	187.5	1,634.8
National forest	40,000	3,426.1	356.8	3,778.4
All other <u>2/</u>	113,230	3,884.9	451.2	4,336.1
Total	201,800	8,879.9	1,005.0	9,884.9

1/ Includes State Land Board lands, State forest lands, and State highway lands used as parks.

2/ Consists mostly of privately owned lands but includes also county, municipal and some Federal lands.

From inspection of the above table, lands of the State of Oregon suffered little, relatively speaking. Both of the indicated classes of Federal holdings had substantial amounts of damage. Of the two Federal ownerships the larger total volume of mortality on national forests stems primarily from the greater area on which blowdown of the "light" class occurred (table 5, Appendix). In blowdown of the classes listed as concentrated, the volume destroyed on lands administered by the Bureau of Land Management was 357.3 million board feet compared with 321.9 for national forest lands.



For the "all other" lands, the volume damaged in the concentrated blowdown category was 762.1 million board feet.

The total damage by blowdown and beetle kill is greater on the private lands than on any one other class of ownership. This emphasis on the private land problem should not be interpreted as detracting from the seriousness of the problem in the other ownership classes. With a total estimated damage of 5,413.2 million board feet, the lands of the Federal Government present a very serious problem, and one that has a high potential for additional loss. This problem is accentuated by the inaccessibility of some of these lands.

It should be borne in mind that these figures are log scale, and represent net volumes. They also represent only the beetle kill as of July 1952 (i.e. the 1951 kill) and the blowdown of the winter of '51-'52, and do not include volumes of timber killed in the fires of 1951. Some other estimates of damage that are at variance with those given in this report have been made by various agencies and companies for parts of the project area. In the cases that have been analyzed, discrepancies stem primarily from differences between figures for gross and net volumes, or the inclusion of volumes of fire kill or volumes of blowdown of earlier years. Also, as of the date of this report all holdings would show damage greater than that included in the tables herein because of the additional damage from 1952 attacks of the beetle, which was not evident from the air at the time of this survey.

#### Accuracy of Results.

The statistics reported in this report are subject to two types of error: (1) sampling error; and (2) technique error. Sampling error, which results from the fact that areas and volumes are determined by a sample rather than by 100-percent measurement, can be calculated. Errors of technique, which come from mistakes in measurement of area or volume, cannot be evaluated.

The summary table on page 16 in the section headed "The Findings" as well as tables 2 and 3 in the Appendix show figures for estimated sampling error. These are the calculated errors which are associated with the sampling scheme used and have nothing to do with the technique errors that undoubtedly were made from time to time. The sampling error for the estimate of net board-foot volume lost was calculated to be 17 percent, on the basis of one standard error. This means that for the total volume of 9,885 million board feet the chances are two out of three that this total volume is within 17 percent of the value that would be obtained if the same area were inventoried 100 percent by the same methods.

The sampling errors shown in tables 2 and 3 were computed by standard methods except in the case of the blowdown area estimate for the Cascade portion. Here the area estimate was obtained from a series of strip

samples of varying length. In order to get an estimate of variance for this area estimate, the Cascade portion was broken up into arbitrary sampling units of quadrangle size.

An examination of the sampling errors shows that those for the Cascade area are considerably higher than those for the Coast. This is due primarily to the fact that much more effort was expended in the Coast than in the Cascades. Early ground reports, on which the design of the survey was based, indicated that more blowdown had occurred in the Coast than in the Cascades. This turned out to be substantially true for the concentrated blowdown but the large amount of scattered blowdown in the Cascades was not expected.

The errors of technique which may have occurred are impossible to evaluate. Every effort was made through training to insure that these errors were at a minimum and were compensating. Probably the greatest chance for technique errors occurred in the aerial mapping of blowdown areas. Here, in the training process, there was only a limited opportunity to check on the aerial mapper's ability to estimate proper size and shape of blowdown areas. This was due to the fact that the blowdown areas seldom had definite boundaries that could be recognized on the ground. Instead, they were largely boundaries between differing percentages of blowdown. Every effort was made by the ground crews to sample the areas mapped so that the average blowdown volumes would be truly representative of these areas. It is believed that the acreage figures are sufficiently reliable for the purposes of this survey.



## SIGNIFICANCE OF FINDINGS

From the discussion in the preceding section it is apparent that the timber mortality adds up to a bad situation. It may well get worse before it gets better. This particular bark beetle has not before in recorded history of the region been present in the tremendous population numbers known to exist now. Consequently it is possible that this infestation could take a different course than have the other known infestations of Douglas-fir bark beetle which flared up and died out in a matter of 2 or 3 years. A large forest fire creates its own drafts and behaves in a manner different from that of a smaller forest fire. A fire fighter who has never observed the way a large fire behaves may be misled if he judges what to expect entirely from his experience with smaller fires. The possibility of a parallel situation should not be overlooked in forecasting what to expect of the present bark-beetle infestation.

### Further Beetle Killing.

Obviously, further beetle killing should be expected. The 1952 flight of beetles, which was completed during the summer, no doubt brought attacks to most of the estimated 8.9 billion board feet of blowdown, as well as bringing attacks to many millions of board feet of standing green trees. In addition, it is now known that there are a number of important infestation centers outside of the project area shown in map 1. From these facts it is reasonable to assume that there was, during the winter of 1952-53, substantially more than nine billion board feet of infested timber, not including the one billion board feet killed by beetles in the 1951 attacks. From this total should be deducted the volume of infested or blown-down timber that was removed from the woods by logging in 1952, of which there is no detailed record.

Blown-down timber is highly desirable host material for the beetles in which populations may build up several times more rapidly than in green standing timber. The 1953 attack was undoubtedly made by a much larger beetle population than that which made the 1952 attack, which in turn was probably a good deal larger than the 1951 population. And the 1951 attack killed a billion feet of timber. Naturally, the effects of controls by nature have not and cannot be fully evaluated. Undoubtedly these controls have increased in number with the beetle population. It seems not unreasonable to anticipate additional killing by beetles by the end of the outbreak to be in the order of 2-5 billion board feet.

The additional killing that occurs will not be spread evenly around the affected area. It will be heaviest in the areas that are shown on the maps as having both a heavy infestation in the summer of 1952 and moderate to heavy blowdown resulting from '51-'52 winter storms. It is likely to be severe in the areas that were shown by the 1952 survey to have both infestation and blowdown, even though neither was classed as heavy. And it will not be confined to these areas. Further developments to be expected are: The perimeter of the infestation area will

enlarge; the scattered clumps of infestation found in the summer of 1952 along the west slope of the Cascades north of the Santiam River drainage will fill in more solidly; and new infestation areas will develop. Particularly may new centers be expected along the west slope of the Cascades in the State of Washington where groups of killed trees have shown up since the July 1952 aerial survey was made.

In a smaller infestation of this beetle, and with no additional windthrow, the normal thing to look for would be a tapering off of population starting in 1954. This would mean that there would be a substantial reduction in the kill resulting from the 1954 attack and a noticeable decrease in new red tops showing up in the woods in the fall of 1954 and the spring of 1955. There would be killing for the next couple of years at least, but at a rapidly dropping rate. But that is a normal forecast, based on a smaller beetle population. No one can yet say for sure whether the current infestation will follow that pattern or will create a pattern of its own.

#### Additional Blowdown or Fire Kill.

Large additional volumes of windthrow or fire kill will prolong the life of this infestation. There was some blowdown during the 1952-53 winter. As of the spring of 1953, the Portland Forest Insect Laboratory had received almost as many reports of blowdown as had been received on the same date a year ago. But these reports do not provide an adequate basis for judging whether or not the '52-'53 blowdown is as serious as was that of the year before. Whatever the amount of blowdown turns out to be, it will provide a corresponding amount of favorable breeding material for the beetle. Any additional extensive fire killing of Douglas-fir also would serve to build up the beetle population.

#### Control Possibilities.

There is no known practical method to control this infestation by spraying, from either the air or the ground. To apply penetrating oils would require cutting down the infested trees. This would be such a monumental job and would be so expensive (at an estimated \$40 per tree) as to be impracticable. This leaves logging as the only known practical measure forest managers can take to influence the course of the infestation.

The major considerations involved in logging for control are discussed under the heading of "Recommendations."

#### Fire Hazard.

The volume of both blowdown and beetle kill will add materially to fire protection problems, primarily to the extent that they increase the amount and volume of hazardous fuel. In portions of the



area covered by the 1952 survey, entire townships have become as hazardous as old burns because of the general and widespread pattern of the dead fuel that has been created. Landowners and land managers will need to remain acutely aware of this increase in hazard until appropriate fire prevention measures can be taken. In some of the more remote areas where logging will necessarily be deferred until sometime in the future, there appears to be no choice except to intensify the fire prevention program.

#### Timber Deterioration.

A matter of very practical concern in this situation is the question of how much real volume loss there will be because of deterioration of wood in the standing or blown-down trees between the time they are killed and the time they can be reached for salvage. Douglas-fir deteriorates much less rapidly than do many other Pacific Northwest species. The sapwood decays fairly rapidly, but the heartwood remains usable for a good many years. A small-scale study in 1952 of standing beetle-killed Douglas-fir trees 180 years old in Coos County, Oregon, by Ernest Wright and Kenneth H. Wright (4) indicates that the sapwood (approximately 20 percent of the tree volume) is gone in three years, but by the end of six years approximately 75 percent of the wood volume is still sound. Deterioration in younger trees would be much faster, while in older timber it would be somewhat slower.

Undue optimism should not be associated with the fact that substantial volumes of merchantable material are still being obtained from standing snags cut and removed from the Tillamook Burn. By and large, this timber was very large old-growth, with a high percentage of heartwood. At present the percentage of recovery is quite low. There is some evidence that trees killed by fire are almost immediately dried out to where subsequent deterioration by fungi and insects is relatively slow as compared to beetle-killed trees. The Douglas-fir beetle is known to carry the spores of wood-rotting fungi, and the recent study indicated that rot had advanced much faster in the parts of the tree heaviest attacked by the beetles. Since the beetles have also attacked the windthrow, this factor is of probably equal importance in this material.

Cognizance should also be made of the fact that breakage when falling the beetle-killed timber will be higher than in green trees. Fallers have already made this observation in trees beetle-killed in 1951. In the blowdown of course, this will not be a factor. However, due to the difficulty in bucking jack-strawed windthrow, loss in scale has also been encountered due to making "relief cuts" to release stresses.

It can be concluded that there will be considerable loss from deterioration. This loss will increase the longer salvage is postponed.

## RECOMMENDATIONS

### Logging for Beetle Control.

Logging for this purpose is not ordinary salvage logging. In the course of a good many years, all of the timber damaged in this infestation should be salvaged if possible, simply to avoid the waste of not using it. But logging that will have an influence in controlling the beetle population must be done with the occurrence and habits of the beetle positively worked into the logging plans.

In logging for control of the Douglas-fir beetle effort should be directed toward removing from the woods the greatest possible volume of the following two types of Douglas-fir trees: (1) Trees that have beetles in them from the previous year's attacks, and (2) trees that have been freshly killed or weakened by fire, wind, logging injury or other causes.

In fall and winter logging, first priority should be given to removal of the first type of trees, since the beetles may emerge from these trees as early April (in western Oregon and Washington) to make new attacks. In late winter or early spring these infested trees will be of the following kinds: Trees that died the previous fall but have since lost their needles; trees whose foliage is just fading to yellow or red in color; or trees whose foliage has not yet faded. All of these trees will have old boring dust in the crevices of the bark, and the broods of beetles can usually be found by removing a section of the bark.

After the flight is well under way in the spring there is little control value in removing the above-mentioned trees from the woods. Then the salvage should shift to removing blowdown or damaged trees of the immediately preceding winter, and the green standing trees to which the beetles have spread in their new attacks from the "abandoned trees."

In summary, the trees preferred as hosts are the green wind-thrown or felled trees, during the first season following their fall; fire-killed timber, the first year after it has been killed; and green trees in the midst of blowdown or beetle killed groups. Either standing trees or windthrow under attack are detected by the red boring dust exuded from the entrance galleries of the beetles and lodged in bark crevices.

Logging shows frequently cannot be laid out exclusively for beetle control. Consequently logging for control becomes a matter of working beetle-control considerations into logging plans to the greatest practical extent. Leeway for these considerations exists primarily in the location of roads and settings. For these reasons there is pressing



need from a beetle-control standpoint for operators and landowners to look ahead to the expected beetle situation in their areas in the fall of 1953 and the spring of 1954, when planning roads to be built. Any who have a choice on where to operate in 1954 should now be planning roads to open up presently inaccessible areas where beetle population problems will be serious in 1954 and later.

It is hard to over-emphasize the need for roads to make more areas accessible so that logging operations can more nearly keep abreast of the need for salvage. Thousands of miles of road are needed. Until these roads are built, situations such as the present one will continue to present emergency problems that can be met only by emergency action. When the forests of the region have been made accessible by main roads it will be possible to initiate corrective action sooner, to pinpoint localities where such action is needed, and to move faster when the need arises. For lack of that sort of road system, the best control that can be accomplished through logging now will be inadequate. Even so, the maximum possible effort in this means of control should be made. In some localities salvage can be quite effective in reducing beetle-caused losses.

#### Protection Against Fire.

The generalized material presented in this final report is not specific enough to aid landowners or fire-protection agencies in determining how much the fire hazard has been increased on their areas. Nor can this report indicate for particular areas how much worse the local situation will become. However, the one-inch-to-the-mile-scale quadrangle maps which were published in October of 1952 give detailed information which should be of material help in analyzing local problems.

All people concerned with financing fire control or with decisions on strength of protection organization necessary should be aware of the fact that the problem of protection against fire has been aggravated by the present situation, particularly the beetle infestation. The impact of the present catastrophe on fire control will continue as long as large volumes of dead standing and down timber remain unsalvaged.

#### Surveys.

Forest landowners and managers should take the initiative about making whatever local, intensive surveys they need to keep themselves informed of changes in the infestation on their own lands. Marked changes can take place in a relatively short time. The only way to keep currently informed on the situation is for land managers to stay on the alert. Even repeating the 1952 cooperative survey would not replace this need. In localities where the likelihood of new blowdown (winter 1952-53) is high, the need for such local, intensive surveys is especially important.

Some additional region-wide surveys are needed in 1953, and probably also in the succeeding several years, to record the general progress of the infestation and ascertain significant shifts in intensity which should be called to the attention of the people concerned. These surveys do not need to be as detailed as was the 1952 survey but should cover more of the Douglas-fir region. Information of two types is required. The first will answer this question--what changes are taking place in the boundaries of the infested area and how serious are these changes? The second will answer the question--what shifts in intensity of infestation are taking place within the large area already affected, and what action is indicated because of these shifts? In part, the data can be obtained from reconnaissance type aerial detection surveys which should extend from the Oregon-California boundary to as far north as necessary in the Cascade Mountains of Washington. In part, the data will have to be obtained by ground checks, or aerial photo plots if techniques for analyzing the plots can be satisfactorily developed.

#### Research.

Further studies are needed to improve the techniques for making surveys. Both color and panchromatic aerial photography were tested in a preliminary way last summer as a basis for following infestation trends and making estimates of kill on a region-wide basis. The tests showed very encouraging results, especially for the color photography. These experiments should be continued with the objective of designing photo-sampling schemes that can be put into use in the summer of 1953 and continued year after year for as long as necessary. Further ground sampling will be needed while the aerial techniques are being worked out.

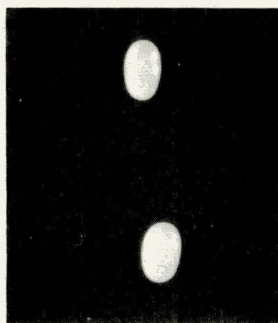
Entomological studies of the Douglas-fir beetle are in progress. Intensive study plots that were installed in Coos County, Ore., before the present epidemic began have given invaluable information on the sequence of events that led to the outbreak and on the trend of the epidemic on the study area. A considerable amount has been learned regarding the habits of the beetle but many phases of the over-all beetle problem critically need investigation. Some of the most important of these are: (1) The biology and natural control of the beetle; (2) the effect of climate on the abundance of the beetle; (3) the type of tree and stands preferred by the beetle; (4) the rate of deterioration of beetle-killed trees under a variety of conditions; and (5) methods of control or prevention of epidemics with special emphasis on forest management techniques. The optimum time to study these items is when an epidemic is in progress.



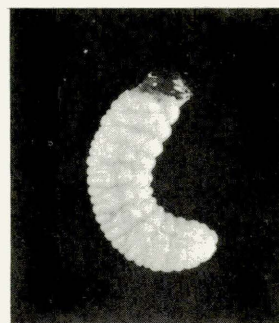
PLATE IV. THE DOUGLAS-FIR BEETLE AND ITS WORK



Adult, (X 8)



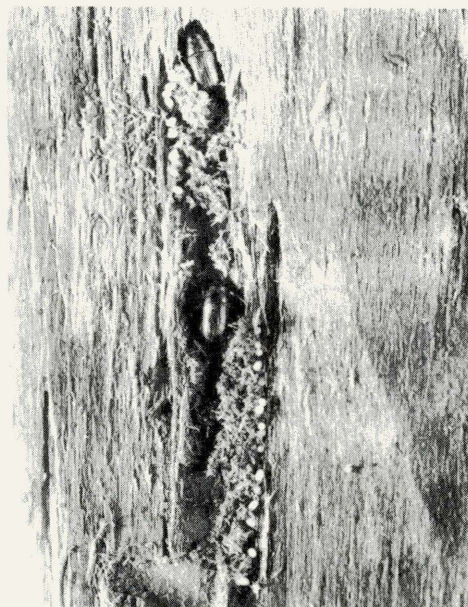
Eggs, (X 8)



Larva, (X 8)



Bark removed from heavily attacked tree



Egg deposition--female in front



Typical larval galleries in inner bark

#### LITERATURE CITED

- (1) Pacific Northwest Forest and Range Experiment Station, June 24, 1952. Operations Manual, Blowdown - Bark-Beetle Survey. (Administrative report, mimeographed).
- (2) Weyerhaeuser Timber Company, Oregon State Board of Forestry, and United States Bureau of Entomology and Plant Quarantine, April 28, 1952. Report of Reconnaissance Surveys of the 1951 Douglas-Fir Bark Beetle Epidemic in Oregon and Washington. (Mimeographed).
- (3) Wright, Kenneth H., and Lauterbach, Paul, June 1, 1952. Report on a Test to Determine the Feasibility of Aerial Mapping and Counting of Trees Killed by the Douglas-Fir Beetle. (Mimeographed).
- (4) Wright, Ernest and Wright, Kenneth H. December 1, 1952. Progress Report, Deterioration of Beetle-Killed Douglas-Fir in the Millicoma Area of Coos County, Oregon. (Processed).



A P P E N D I X

Table 1.—Acreage of concentrated blowdown by counties

(Acres)

County	Class of blowdown <u>1/</u>			
	Heavy	Moderate	Cut over	Total
Coast Area				
Tillamook	147	53	140	340
Yamhill	22	18	280	320
Lincoln	2,163	1,564	2,090	5,817
Polk	578	142	740	1,460
Benton	1,002	818	2,550	4,370
Lane	11,023	7,411	13,900	32,334
Douglas	15,021	21,899	15,770	52,690
Coos	7,585	6,701	10,490	24,776
Curry	1,641	2,145	510	4,296
Josephine	129	357	130	616
Total, Coast	39,311	41,108	46,600	127,019
Cascade Area				
Skamania	181	886	493	1,560
Klickitat			164	164
Subtotal, Wash.	181	886	657	1,724
Multnomah			110	110
Hood River	652	195	657	1,504
Clackamas	1,479	1,078	1,698	4,255
Marion	98	98	712	908
Linn	3,116	3,337	5,531	11,984
Lane	8,597	11,909	14,073	34,579
Douglas	3,393	5,791	9,750	18,934
Jackson	41		712	753
Josephine			30	30
Subtotal, Ore.	17,376	22,408	33,273	73,057
Total, Cascades	17,557	23,294	33,930	74,781
Grand Total	56,868	64,402	80,530	201,800

1/ These classes are defined as follows:

Heavy - 25% or more of the stems blown down.

Moderate - 10-25% of the stems blown down.

Cut over - 25% or more of the stems blown down in cut-over areas.



Table 2.--Total net volume of blowdown and beetle-killed timber by counties

(Million board feet, log scale, Scribner)

County	Blowdown all species					Beetle-killed Douglas- fir	Total volume killed
	Class of blowdown				Total		
	Heavy	Moderate	Light	Cut over			
Coast Area							
Tillamook	3.2	0.2	13.5	0.6	17.5	0.1	17.6
Yamhill	0.5	0.1	15.6	1.1	17.3	1.7	19.0
Lincoln	46.5	4.9	123.2	8.4	183.0	5.0	188.0
Polk	12.4	0.4	15.6	3.0	31.4	7.2	38.6
Benton	21.5	2.6	20.6	10.3	55.0	12.2	67.2
Lane (West)	204.4	32.6	284.2	56.1	577.3	29.1	606.4
Douglas (West)	176.0	111.4	1,259.9	63.7	1,611.0	272.2	1,883.2
Coos	199.4	41.1	452.5	42.3	735.3	97.7	833.0
Curry	43.2	13.1	402.4	2.1	460.8	25.6	486.4
Josephine (West)	1.5	1.8	56.9	0.5	60.7	4.0	64.7
Total Coast	708.6	208.2	2,644.4	188.1	3,749.3	454.8	4,204.1
Cascade Area							
Skamania	1.0	4.7	122.4	2.2	130.3	28.7	159.0
Klickitat	-	-	9.8	0.7	10.5	4.8	15.3
Total Wash.	1.0	4.7	132.2	2.9	140.8	33.5	174.3
Multnomah	-	-	32.3	0.5	32.8	0.1	32.9
Hood River	3.7	1.0	46.4	3.0	54.1	2.9	57.0
Clackamas	8.5	5.8	578.1	7.7	600.1	29.6	629.7
Marion	0.6	0.5	201.1	3.2	205.4	2.5	207.9
Linn	17.9	17.9	769.3	24.9	830.0	39.9	869.9
Lane (East)	49.4	63.8	1,274.2	63.4	1,450.8	210.3	1,661.1
Douglas (East)	19.5	31.0	1,620.3	43.9	1,714.7	229.8	1,944.5
Jackson	0.2	-	68.9	3.2	72.3	0.8	73.1
Josephine (East)	-	-	29.5	0.1	29.6	0.8	30.4
Total Oregon	99.8	120.0	4,620.1	149.9	4,989.8	516.7	5,506.5
Total Cascade	100.8	124.7	4,752.3	152.8	5,130.6	550.2	5,680.8
Grand Total	809.4	332.9	7,396.7	340.9	8,879.9	1,005.0	9,884.9
Estimate of Sampling Error							
Coast Area	13%	16%	21%	31%	15%	10%	13%
Cascade Area	45%	38%	34%	50%	31%	18%	28%
Total sampling error	-	-	-	-	19%	11%	17%

Table 3.--Total net volume of blowdown and beetle-killed timber by counties

(Thousand cubic feet)

County	Blowdown all species					Beetle-killed Douglas- fir	Total volume killed
	Class of blowdown				Total		
	Heavy	Moderate	Light	Cut over			
Coast Area							
Tillamook	525	28	2,196	110	2,859	22	2,881
Yamhill	79	10	2,540	220	2,849	287	3,136
Lincoln	7,725	826	20,112	1,640	30,303	840	31,143
Polk	2,064	75	2,540	580	5,259	1,192	6,451
Benton	3,578	432	3,363	2,001	9,374	2,028	11,402
Lane (West)	33,103	5,437	45,831	10,905	95,276	4,481	99,757
Douglas (West)	29,211	18,122	210,006	12,373	269,712	43,962	313,674
Coos	30,234	6,435	73,806	8,230	118,705	14,598	133,303
Curry	6,541	2,060	65,626	400	74,627	3,825	78,452
Josephine (West)	251	295	9,483	102	10,131	639	10,770
Total Coast	113,311	33,720	435,503	36,561	619,095	71,874	690,969
Cascade Area							
Skamania	169	732	20,870	366	22,137	4,421	26,558
Klickitat	--	--	1,679	122	1,801	733	2,534
Total Washington	169	732	22,549	488	23,938	5,154	29,092
Multnomah	--	--	5,517	82	5,599	18	5,617
Hood River	609	161	7,916	488	9,174	448	9,622
Clackamas	1,381	891	98,591	1,262	102,125	4,561	106,686
Marion	92	81	34,303	529	35,005	385	35,390
Linn	2,910	2,759	131,214	4,110	140,993	6,141	147,134
Lane (East)	8,030	9,845	217,331	10,458	245,664	32,366	278,030
Douglas (East)	3,169	4,787	276,342	7,246	291,544	35,363	326,907
Jackson	38	--	11,754	529	12,321	127	12,448
Josephine (East)	--	--	5,037	22	5,059	122	5,181
Total Oregon	16,229	18,524	788,005	24,726	847,484	79,531	927,015
Total Cascade	16,398	19,256	810,554	25,214	871,422	84,685	956,107
Grand Total	129,709	52,976	1,246,057	61,775	1,490,517	156,559	1,647,076
Estimate of Sampling Error							
Coast Area	12%	15%	20%	23%	14%	10%	13%
Cascade Area	42%	33%	30%	45%	28%	18%	25%
Total sampling error	-----				17%	11%	16%



Table 4.—Acreage of concentrated blowdown by ownership class

(Acres)

Ownership class	Class of blowdown			
	Heavy	Moderate	Cut over	Total
National forest	17,339	19,662	2,999	40,000
BLM Administered Lands	13,755	17,390	13,230	44,375
State of Oregon <u>1/</u>	1,733	1,422	1,040	4,195
All other <u>2/</u>	24,041	25,928	63,261	113,230
Total	56,868	64,402	80,530	201,800

1/ Includes State Land Board lands, State forest lands, and State highway lands used as parks.

2/ This category was not compiled separately. It is comprised largely of privately owned lands but includes also county-owned land, some municipal and some Federal lands.

Table 5.--Net volume of blowdown and beetle-killed timber  
by ownership classes

(Million board feet, log scale, Scribner)

Ownership class	Volume killed			
	Concentrated blowdown <u>1/</u>	Scattered blowdown	Beetle- killed	Total
✓ National forest	321.9	3,099.7	356.8	3,778.4
BLM Administered Lands	357.3	1,090.0	187.5	1,634.8
State of Oregon <u>2/</u>	41.9	84.2	9.5	135.6
All other <u>3/</u>	762.1	3,122.8	451.2	4,336.1
Total	1,483.2	7,396.7	1,005.0	9,884.9

1/ This is the blowdown that occurred on the 201,800 acres shown in table 4 as concentrated blowdown.

2/ Includes State Land Board lands, State forest lands, and State highway lands used as parks.

3/ This category was not compiled separately. It is comprised largely of privately owned lands but includes also county-owned land, some municipal and some Federal lands.



Table 6.--Amount and source of project funds

<u>Source</u>	<u>Amount</u>
Oregon State Board of Forestry	\$ 10,000.00
Contributed (see table 1)	10,882.71
Forest Pest Control Funds, U. S. Forest Service	<u>62,718.27</u>
Total	\$ 83,600.00

Table 7.--Project costs by major activities

Activity	Project costs			Contributions from nonproject funds <sup>1/</sup>	Net cost to project funds
	Salary and per diem	Other	Total		
Technique study	\$ 2,354.59	\$ 765.16	\$ 3,119.75	\$ 622.53	\$ 2,497.22
Aerial operations	22,850.49	20,760.02	43,610.51	5,817.32	37,793.19
Ground cruising	14,257.13	638.30	14,895.43	3,545.00	11,350.43
Computing and publishing	6,261.54	7,734.65	13,996.19	350.00	13,646.19
Trend study (photography)		2,150.00	2,150.00		2,150.00
Direct project overhead	5,508.10	321.00	5,829.10	547.86	5,281.24
Totals	\$ 51,231.85	\$ 32,369.13	\$ 83,600.98	\$ 10,882.71	\$ 72,718.27

<sup>1/</sup> Includes nonreimbursed contributions of men and services directly to this survey from the following agencies:

1. U. S. Bureau of Entomology and Plant Quarantine.
2. Oregon State Board of Forestry.
3. U. S. Weather Bureau.
4. U. S. Bureau of Land Management.
5. Industrial Forestry Association.
6. U. S. Forest Service.



Table 8.--Project costs by objective classes  
(Including contributions from nonproject funds)

Code No.	Item	Subtotals	Total
01	Personal services		\$ 37,916.37
02	Travel		13,315.48
04	Communications		675.00
05	Rents and utilities		78.90
07	Other contractual services		22,197.63
	Airplane rental	\$ 13,929.16	
	Airplane repairs & Inspections	418.47	
	Special study photography	2,150.00	
	Map production & cartographic services	5,700.00	
08	Supplies and materials		7,935.60
09	Equipment		<u>1,482.00</u>
	Total		\$ 83,600.98

Table 9.--Airplane hours flown by principal activities

<u>Activity</u>	<u>Hours &amp; Minutes</u>	<u>Percent of total</u>
Technique study	53:42	6.81
Training	88:39	11.25
Survey mapping	434:49	55.16
Scouting areas not mapped	78:19	9.93
Weather check flights	8:08	1.03
Post-survey photo sampling	31:10	3.95
Ferry to and from project, repair trips and miscellaneous	<u>93:35</u>	<u>11.87</u>
Total	788:22	100.00



Table 10.--Unit cost and production statistics

(For possible use in estimating costs or production for future similar projects).

A. Total cost per mapping hour flown.

Total cost of project	\$83,600.98
Airplane hours flown in survey mapping	434.8 hours
Total cost per mapping hour flown	192.27

B. Total cost of aerial operations per mapping hour flown.

Cost of aerial operations	\$43,610.51
Airplane hours flown in survey mapping	434.8 hours
Cost per mapping hour flown	\$ 100.30

C. Direct cost for airplanes and aerial crews per mapping hour flown.

Cost items:

Airplane rental	\$15,382.15 <u>1/</u>
Airplane gas, oil, repairs and inspection	3,062.26
Salaries and on-project travel expenses of flying personnel	18,315.63

(Total) Direct cost of aerial operations	\$36,760.04
Airplane hours flown in survey mapping	434.8 hours
Cost per effective plane hour	\$ 84.54

1/ Includes \$1,452.99 rental allowance for hours flown by BEQ plane for which rental was not charged to the project.

D. Direct cost for airplanes and pilots only per hour flown for all purposes and per mapping hour flown

Cost items:

Airplane rental <u>1/</u>	\$15,382.15
Airplane gas, oil, repairs and inspection	3,062.26
Salaries and on-project travel costs of pilots	6,090.11
Cost of getting pilots to and from project	252.54

Total, this cost	\$24,787.06
Total airplane hours flown	788.4 hours
Cost per airplane hour flown for all purposes	\$ 31.44
Airplane hours flown in survey mapping	434.8 hours
Cost per mapping hour flown	\$ 57.01

1/ Same footnote as table C

Table 10, Cont'd.

E. Machine costs for rented airplanes.

Actual rental paid for rented airplanes	\$13,929.16
Number of hours flown by rented airplanes	709.5 hours
Average rental cost per hour for rented planes (exclusive of gas, oil, repairs and pilot time)	\$ 19.63

F. Production per mapping hour flown.

Total number of square miles mapped from the air	18,060
Number of airplane hours flown in survey mapping	434.8
Production in square miles per mapping hour flown	41.5

G. Comparison of the above unit costs and production figures if the flying period had been extended 50% because of weather, with no increase in the number of hours flown.

<u>Unit item</u>	<u>Amount from above tables</u>	<u>Amount with 50% Extension of flying period</u>
Total cost of project per mapping hour flown	\$ 192.27	\$ 215.25
Direct cost for airplanes and aerial crews per mapping hour flown	84.54	107.52
Total cost of all aerial opera- tions per mapping hour flown (From B)	100.30	123.27
Production in square miles per mapping hour flown	41.5	41.5

H. Cost per plot for ground cruising.

All costs allocated to ground cruising	\$14,895.43
Total number of plots located, laid out, and cruised	262 plots
Cost per plot	\$ 56.85

I. Man day production for ground cruising.

Number of man days allocated to ground cruising	445
Number of plots	262
No. of man days per plot	1.7
No. of plots per man day	.59



## COOPERATION IN THE PROJECT

This survey was a cooperative project throughout. The need for the information obtained was first pointed up strongly at meetings of the Northwest Forest Pest Action Committee, a group representing interested forest landowners, operating companies, and State and Federal forestry agencies. The boundaries of the area that should be covered were largely determined from work done in a cooperative reconnaissance survey in the early spring of 1952 by the Oregon State Board of Forestry, the Weyerhaeuser Timber Company and BEPQ's Portland Forest Insect Laboratory.

A major aim of all groups that have been interested in appraising this infestation has been to get word about it to land managers and loggers in order to encourage salvage logging. A subcommittee of the Northwest Forest Pest Action Committee has been especially active in this regard. This Douglas-Fir Subcommittee held meetings throughout western Oregon and has been responsible for much publicity about the seriousness of the infestation and the need for action to obtain salvage logging. Both the Portland and Eugene offices of the Industrial Forestry Association have worked very closely with the Douglas-Fir Subcommittee in getting out publicity, and independently in carrying word to individual loggers and forest landowners. The Industrial Forestry Association was particularly helpful in getting the detailed quadrangle maps into the hands of those who could use them in planning salvage. The Association also made its facilities available for coordinating and screening orders for the finished survey maps.

The survey itself made use of personnel, money, and services from a total of 11 different sources. The Oregon State Board of Forestry contributed \$10,000 in cash, and in addition contributed the services of four field men for the entire project, together with their transportation costs and vehicles for their transportation. Other personnel assigned or detailed to the project came from the following firms or agencies: Willamette Valley Tree Farm Management Service; Region 1 of the U. S. Bureau of Land Management; Region 6 of the U. S. Forest Service; the Portland, Oregon, Berkeley, California, and New Haven, Connecticut offices of the Division of Forest Insect Investigations, U. S. Bureau of Entomology and Plant Quarantine; the Seattle Office of the U. S. Weather Bureau; and the Pacific Northwest Forest and Range Experiment Station, Portland. The personnel roster shown in this Appendix, lists the individuals who came from these various agencies, and shows the positions they occupied.

It was necessary that most of the people assigned to this project have experience qualifications which could not be met by green men. Hence for the most part the personnel made available were taken from important jobs on which they were already engaged. Accordingly,

even though they were paid from funds set up for this project, the fact that they were loaned at an extremely busy time of year represents a substantial contribution to the survey from the various units that agreed to detail men to it.

Special mention is due the U. S. Weather Bureau. Although the project developed on short notice, that Bureau assigned a fire weather expert to set up a special forecasting service for this project, and then assigned two top forecasters from the Seattle office to man the service. The availability of the expert weather forecasting service was one of the important factors in permitting the survey to be pushed through ahead of schedule.

The three-color maps which appear in this report and the report entitled, "Summary Statement on the 1952 Blowdown-Bark-Beetle Survey in the Douglas-Fir Region of Oregon and Washington," dated October 20, 1952 were printed by the Industrial Forestry Association.

There are several units among the Federal agencies that performed important parts of this work. The Cartographic Section, Division of Engineering, Region 6, U. S. Forest Service agreed to do so much work for this survey that it was necessary to rearrange work schedules in that Section. One of the first urgent needs was for maps on which pre-planned flight lines could be placed. Parts of the project area were covered by recently published, good quality quadrangle maps. Other parts were covered by maps for which field work had been done but the maps themselves had not been drawn. Still others were covered by only obsolete one-half-inch scale Forest Service base maps, practically lacking in topography. By diligent culling, patching, and fitting, the Cartographic Section worked out fifteen-minute quadrangle maps on a one-inch-to-the-mile scale for the full 11,500,000-acre project area. A fifteen-minute quadrangle map covers approximately 135,000 acres or 210 square miles of area. When the flight lines had been laid out, 15 copies of each of the 109 quadrangles showing flight lines were printed, for the use of the aerial crews, and other project personnel. After the flying was completed, the Section redrafted a number of the quadrangle base maps and made plates for multilith reproduction of 89 base maps and 89 red overprints to appear on each of the base maps. In addition, the Section provided mapping and drafting advice throughout the project.

Outstanding help was also given by the Cartographic Section of Region 7 of the Soil Conservation Service. That Service multilithed the two-color maps for the 89 quadrangles that were published.

Help on another critical item came from the Supply Officer of Region 6, U. S. Forest Service. Had it not been possible to obtain a sufficient number of Cessna 170-B airplanes at the time they were needed, it is probable that the survey could not have been made within the



time limits of the project. That plane desired for the job had been on the market for only about a year. The Supply Officer canvassed virtually the entire western United States in order to locate and contract planes in time.

The Weyerhaeuser Timber Company was most obliging in making available to the Station and the Laboratory the results of independent work done by the Company on two tracts in western Oregon. That company's detailed work in air and ground mapping of beetle-killed trees provided a check and one basis for developing an adjustment factor in calculating the volume of beetle-killed timber as shown in tables 2, 3 and 5.

The Safety Officer of Region 6, U. S. Forest Service, gave a great deal of time and thought to the safety problems presented by this project. He reviewed plans at several stages of the planning; he participated in preparing the contract for the airplanes; he made a number of inspections while the aerial work was progressing; and was in general helpful and constructive throughout the project.

Eugene personnel of the Civil Aeronautics Administration cooperated fully in communications problems, especially with a major assist in routine plane contacts while planes were flying some parts of the project area.

The U. S. Bureau of Land Management was one of the major contributors to the project. Personnel from both the regional office in Portland and the district office at Eugene were assigned to various phases of the undertaking. These men and their part in the work are also shown in the Project Roster on page A-15. In addition the Eugene office provided office space and supplies for many of the activities centered there. Mention should also be made of cruise data on areas of blowdown and beetle kill made available by the Bureau and used for establishing mapping standards and checks for the training of aerial observers. No doubt considerable sacrifice was made by this agency to provide the above assistance at a busy time of year.

# PROJECT PERSONNEL

## Roster

<u>Position</u>	<u>Name</u>	<u>Agency</u>
<u>AIR OPERATIONS - HEADQUARTERS, EUGENE, OREGON</u>		
Project Leader to 7/24/52	R. C. Wilson	U.S.F.S. PNW F&R Exp. Sta.
Technical Advisor	K. H. Wright	U.S.B.E.&P.Q. Portland Lab.
Project Leader after 7/25 to 8/20/52		
Air Operations Officer	D. D. Olin	U.S.F.S. Siskiyou N.F.
Chief Pilot	J. F. Wear	U.S.B.E.&P.Q. Portland Lab.
Chief Observer	G. C. Francis	U.S.B.L.M. Eugene District
Field Technician	T. C. Adams	U.S.F.S. PNW F&R Exp. Sta.
Special Weather Forecaster	H. Foltz	U.S. Weather Bureau
Pilots	C. S. Davis	U.S.F.S.*
	J. Harrell	U.S.F.S.*
	E. Hudgins	U.S.F.S.*
	R. M. Lamoureux	U.S.B.E.&P.Q. Oklahoma City, Okla.
Aerial Observers	M. F. Barber	U.S.F.S. Siuslaw N.F.
	H. J. Hawks	U.S.F.S. Gifford Pinchot N.F.
	W. G. Hubbard	Tree Farm Management Service, Eugene, Oregon.
	W. R. Johnson	U.S.F.S. Mt. Hood N.F.
	J. F. Lantz	U.S.B.L.M. Portland, Ore.
	T. McIntyre	U.S.B.E.&P.Q. New Haven, Conn.
	J. W. Merrick	U.S.F.S.*
	P. W. Orr	U.S.B.E.&P.Q. Portland Lab.
	D. B. Robinson	U.S.F.S. Fremont N.F.
	B. Spada	U.S.F.S. PNW F&R Exp. Sta.
	R. E. Stevens	U.S.B.E.&P.Q. Berkeley, Cal.
	J. A. White	U.S.F.S. Willamette N.F.
Clerk	Hazel Northrup	U.S.F.S.*
<u>FIELD INVENTORY - HEADQUARTERS, EUGENE, OREGON</u>		
Field Supervisor	R. B. Pope	U.S.F.S. PNW F&R Exp. Sta.
Cruisers	B. E. Egger	U.S.F.S. Ochoco N.F.
	R. S. Healy	U.S.B.L.M. Roseburg Dist.
	J. G. Krystad	U.S.B.E.&P.Q. Portland Lab.
	W. F. Schaefer	Ore. State Board of Forestry, Salem, Ore.
	M. Y. Thomason	U.S.F.S. PNW F&R Exp. Sta.

\*Employed for this project only.



<u>Position</u>	<u>Name</u>	<u>Agency</u>
Compassmen	D. S. Haskin	Ore. State Board of Forestry, Salem, Ore.
	J. P. Kososki	U.S.B.E.&P.Q.
	M. Lash	U.S.F.S.*
	J. H. Robinson	U.S.B.L.M. Eugene Dist.
	F. W. Sisson	Ore. State Board of Forestry, Salem, Ore.

#### FLIGHT MAP PREPARATION - PORTLAND, OREGON

Supervisor	V. H. Flach	U.S.F.S. Region 6.
Planners	L. A. Carlile	U.S.F.S. Region 6.
	C. W. Gowan	U.S.F.S. Region 6.
	C. Williams	U.S.B.L.M. Region 1.

#### MORTALITY VOLUME COMPILATIONS - PORTLAND, OREGON

Supervisor	R. B. Pope	U.S.F.S. PNW F&R Exp. Sta.
Computers	T. C. Adams	U.S.F.S. PNW F&R Exp. Sta.
	J. M. Myers	U.S.F.S. PNW F&R Exp. Sta.
	E. C. Skinner	U.S.F.S. PNW F&R Exp. Sta.
	M. P. Twerdal	U.S.F.S. PNW F&R Exp. Sta.

#### DRAFTING TO PREPARE FINISHED MAPS - EUGENE AND PORTLAND

Supervisor	T. C. Adams	U.S.F.S. PNW F&R Exp. Sta.
Draftsmen	K. Flaherty	U.S.F.S. PNW F&R Exp. Sta.
	H. Haglund	U.S.F.S. PNW F&R Exp. Sta.
	R. W. Inman	Ore. State Board of Forestry, Salem, Ore.

\*Employed for this project only.

## Personnel Qualifications and Training

For obvious reasons this survey had to have the services of adequately qualified personnel. A great deal of attention was given to the job of recruiting these people, especially the flying personnel, and to their training after they reported to the project. Because the experience on this 1952 survey may be of value to others in weighing the use of the techniques that were employed, the qualifications set up for the different classes of personnel, and the training given these people, they are discussed in some detail below.

### Personnel Qualifications.

All flying personnel were volunteers. Quite a little screening was necessary before the aerial jobs were filled.

Aerial Observers. For the 14 aerial observers (12 regulars plus 2 alternates) the requirements were:

1. Trained foresters or forest entomologists familiar with timber types.
2. Sufficient experience in reading topographic maps and aerial photographs to be able to map while flying at 60 miles an hour.
3. Personalities suited to working with a crew in limited space under conditions requiring close coordination.
4. Reasonable freedom from air sickness.
5. No mental reservations about doing the type of flying involved.

Pilots. Qualifications for pilots were the most exacting since the safety and quality of work depended largely on their experience and flying ability. All pilots were required to meet the qualifications listed in the Forest Service Air Operations Handbook and also to have a currently valid commercial pilot's certificate with appropriate ratings, and a current medical certificate complying with CAA and State regulations. Specific minimum experience requirements of each pilot were:



1. At least 1000 hours of flying experience as pilot in command; the total hours to include the qualifications listed in the next four items.
2. At least 200 hours of cross-country flying.
3. At least 200 hours of flying over mountainous terrain, with landing facilities similar to those found in the project area.
4. At least 100 hours in the same class of plane to be used on the project.
5. At least 100 hours during the preceding 12 months, of which at least 10 hours correspond to conditions described in (3) above.

Ground Crews. Requirements for the six 2-man ground crews were less exacting. These crews consisted of a cruiser and compassman whose duties were to follow rather detailed instructions in establishing and cruising blowdown plots for mortality volume estimates. The cruisers, except for one college senior, were graduate foresters; the compassmen were mostly students from forestry schools. As with the aerial observers, these men were recruited from various parts of the region and were made available by the agencies cooperating in the project.

#### Project Overhead.

The preceding roster of "Project Personnel" shows eight positions at the field headquarters that were essentially either overhead or facilitating personnel. The functions of the positions are largely apparent from the accompanying titles. The people to fill these jobs were very carefully selected from the cooperating Federal agencies. In view of the urgent nature of the work, its short duration, and the need to develop methods and improvise answers to unanticipated questions, eight was a minimum number. The project would probably have benefited by having additional qualified men for overhead positions.

#### Observer Training.

A total of 15 observers was trained for the survey, with each one given a period of preliminary ground orientation followed by 12 hours of instruction in the air. The training program was developed and supervised by the technical advisor, the chief pilot and the chief observer. It covered the various phases as outlined below.

Orientation (6 hours).

A. Ground (no time limits).

1. Discussion of purpose of the project.
2. Study of aerial photographs of windthrow and beetle damage.
3. Familiarization with 1"-to-the-mile topographic quadrangle maps.

B. Air (3 hours).

1. Observations of various intensities of windthrow and beetle damage.
2. Check of map sense using aeronautical charts.
3. Check of general air adaptability.

C. Navigation (3 hours).

1. Tracking on quadrangle sheets at 1500-2000 feet over relatively flat terrain with good landmarks (1-1/2 hours).
2. Tracking on quadrangle maps at 1,000 feet over rough terrain with good land marks (1-1/2 hours).

Intensive Training (6 hours).

- A. Combination tracking and mapping windthrow or beetle kill at 1,000 feet on areas with good detail (1-1/2 hours.)
- B. Combination tracking and mapping windthrow or beetle kill on areas with limited roads and cultural detail (1-1/2 hours).
- C. Mapping of windthrow and beetle-kill on test area containing known amounts of damage (1-1/2 hours).
- D. Mapping of windthrow and beetle kill on areas of difficult terrain and heavy damage (1-1/2 hours).

The first step in the training was to informally get together four or five of the prospective observers as they reported to Portland for assignment, provide them with survey manuals, and discuss the purpose of the survey and how it would be done. Following this orientation they were shown colored slides of the beetle and blowdown damage, and mapping procedures to be used were described. It is well to emphasize the value of slides and photographs for training. Even though the



survey objectives were described in the operations manual and had been discussed at some length verbally, it was not until the men saw the photographs that they clearly grasped the problem at hand.

Samples of the 1"-to-the-mile scale topographic quadrangle maps to be used for the aerial mapping were also provided to the observers for study. Although most of the men were experienced in using maps of this type, generally it had been some time since they had done so, and a short period of brushing-up before using them in the air was welcomed.

Following the ground orientation the observers were taken for flights over an area near Prairie Peak that had been used for the technique development studies and on which there were blowdown patches of known acreage and intensity of damage (percent of stand blown down). Large patches of beetle-killed timber were also present in this area. By viewing these areas of known damage the observers could, for example, adjust their sights to what a patch of 20 acres of 50 percent blowdown looked like, both on a map and as seen from 1,000 feet above the terrain.

As they flew to and from the test area on their first flights the observers were provided with standard Aerial Navigation Charts (1" = 8 miles) on which to map the course of flight. Since these maps show only major physical features such as rivers, peaks, highways and towns they serve well as a starting point in developing navigation and tracking sense.

The next step in the training sequence involved teaching the trainees to follow a course on predetermined flight lines on the quadrangle maps. The maps were mounted on 15" x 17" aluminum sheets and covered with transparent "Friskit" paper that could be erased, thus saving much time in preparing new maps for each observer. Areas with easily recognized topography were flown first. Training then progressed to more difficult terrain as the observers gained experience. Either the technical advisor or chief observer flew with two trainees on these flights and by using known check points could both coach them and test their tracking accuracy.

As shown in the training outline, the intensive training was divided into four phases, all involving a combination of tracking and mapping. Flights followed predetermined flight lines and progressed with each phase to areas of rougher terrain and more intensive damage by wind or beetles, or both. The third area mapped during this sequence was the aforementioned Prairie Peak test area where ground cruises of the tree mortality had been made. This was the only area on which an exact evaluation of the mapping proficiency of the individual observers could be made, and for that reason was of great value both in the training and in evaluating the ability of men.

For the final training flight crews that would fly together on the operational survey were organized, senior observers were appointed, and an area to be practice-mapped was assigned. By practicing together as a crew, the men were able to work out many details of coordination prior to their first operational flight.

### Pilot Training.

The high caliber of the pilots used on the survey contributed greatly to the success of the operation. Had these men not had great skill, and ability to readily grasp this difficult type of flying, the aerial phase of the survey would not have progressed as rapidly nor with as good results.

Pilot training was quite similar in its early stages to that of the aerial observers. However, since all the pilots were experienced in navigation on small-scale aeronautical charts, basic aerial navigation training was not required. The first training phase, therefore, consisted of flights in which the chief pilot flew along flight lines at the normal survey speed and at the proper elevation above the ground while the prospective survey pilot examined the topographic map and tracked his course along the predetermined flight lines. Particular attention was focused upon the relationship of actual ground features to the topographic details on the map. Most pilots readily grasped the "tracking" technique using either planimetric or topographic maps. The next phase was for the new survey pilot to practice the triple job of flying the airplane safely at the required air speed and altitude, recognizing his exact position on the map at all times, and flying the plane precisely along the flight lines inscribed on the map. It was the consensus of all pilots that this particular type of flying required more concentration and skill than any they had ever undertaken. Some pilots were eliminated because they were unable to qualify for the survey flying, even after considerable practice. Pilots who did qualify were of the highest caliber.

As soon as a survey pilot had mastered the required techniques for "grid-iron" flying in cardinal directions he started practice flights with three aerial observers as an aerial survey team. The pilot practiced with the observers on these flights until all members of the team had completed their training and developed into an efficient survey unit.

The pilots were given one additional training flight with the chief pilot. This was done to provide instruction in the contour flying that was used in the deeply dissected terrain of the Cascades areas. Precautions to avoid downdrafts, to approach ridges properly and maintain adequate clearance, and to maintain adequate air speeds at all elevations were stressed as important in maintaining maximum safety at all times.



## Ground Crew Training.

Training of ground crews was of the conventional pattern for this type of work. It was necessary to be sure that these men could use a compass, could read maps, and could note and record essential data for determining gross and net volumes. Since the crews came on the job at different times in July, much of the training was tailored to each man's needs, and was given as the men broke into their work.

## ADMINISTRATION

### Airplane and Equipment

The make and model of aircraft used on the project was the Cessna 170-B. Five of these planes were used for the job, four of which were contracted and used on the operational survey. The fifth plane, property of the Bureau of Entomology and Plant Quarantine, was used for scouting, checking of mapping accuracy, weather flights and standby. Characteristics which make this airplane outstanding for work of this kind are listed below.

1. Excellent forward and lateral visibility for observing.
2. Slow cruising speeds of 50 to 60 miles per hour.
3. Large flaps allow short takeoffs and landings from small fields, plus outstanding rate of climb in emergencies.
4. Slow landing speed of approximately 40 M.P.H. plus all-metal construction provides added safety in case of crash landings.
5. Large cabin provides critically needed space for handling of maps and comfort of observers on long mapping flights.

Very little special aerial equipment was required. In addition to the demountable radio gear discussed under the section on communications, the only items added were fire extinguishers, 10-man first-aid kits, and crash harnesses.

### Flight Organization

All flight operations were under the supervision of the Air Operations Officer. He was responsible for dispatching each daily flight after selection of the areas to be mapped was made by the chief observer, as well as checking on weather conditions, and maintaining flight contact with all crews by radio throughout the day.

Daily operations schedules were made each morning by the chief observer as soon as weather data were available for the project area. Assignments were made to the four crews and posted as shown on form 1. Since assignments were made on a daily basis, preparation of the maps needed for the day's work had to be accomplished each morning before takeoff. The senior observers of each crew were responsible for this task, which involved a great deal of splicing and fitting of maps. This had to be done rapidly in order to be ready by takeoff time.

Headquarters for the project and all flight operations was at the Eugene Airpark, a field maintained by the City of Eugene and serviced by CAA. All aerial operations originated daily from this field except for two-days' work centered at Troutdale, Oregon, when working the farthest north part of the project area. Noon stops, however, were often made at fields close to the particular area being surveyed.

As soon as the daily air operations schedule was posted each morning, the pilots made out Aircraft Flight Clearance reports (see form 2) which were inspected and signed by the Air Operations Officer. These were kept on individual clip boards for each plane by the Air Operations Officer and closed out at the end of each day's flying.

Each pilot also kept a daily flight report (see form 4) showing departure and arrival times, passengers, gas and oil used and any repairs needed on the airplane. The completed forms were submitted at the end of each day to the Air Operations Officer for signature, attention to repairs needed and eventual filing. Individual records as to flight hours, repairs, and gas and oil expenditures were kept for each plane by the Air Operations Officer.

A vitally important phase of the air operations was the daily aircraft inspection service provided by Green's Air Service at the field. This inspection was made each night by an A&E mechanic against a check-off sheet (see form 5) made out by the chief pilot, and assured prompt attention to any repairs needed. The completed inspection forms were signed by the mechanic making the inspection and returned to the air operation office late each evening in order that the pilots could examine them the following morning to see what repairs had been made on their planes. Standard 25 and 100-hour checks were also provided at the field by the Air Service.



## Safety Precautions

### General.

Safety measures provided for the project were largely dictated by U. S. Forest Service and CAA requirements and resulted in a safety record of no airplane accidents or forced landings, and no lost-time injuries to any air or ground personnel. Special safety precautions for the aerial phase of the project were issued in the survey Operations Manual. In addition to these general precautions a detailed "Emergency Search and Rescue Plan" was prepared by the Air Operations Officer. This plan provided an immediate course of action in case of forced landing or crash, either at the airfield or over the survey area. Copies of the plan were distributed to national forests and other agencies that would be involved in rescue operations in case of accident.

Chest-pack type parachutes were worn on all flights and provided an added measure of safety, particularly when ferrying to and from the survey areas (see Plate V). When actually flying the flight lines at 800 to 1,000 feet above the terrain the parachutes were worn, but in most cases this elevation would not have been sufficient to allow jumps in case of emergency. Pilots were continually on the alert, however, for emergency landing spots when following the flight lines.

### Communications.

The excellent radio communication system between ground stations and the airplanes was a major feature of the safety aspects of the project. This communication net was organized through the combined efforts of the Project Supervisor, the Civil Aeronautics Administration and the U. S. Forest Service. Details of the manner in which the system operated are shown in the following chart and described in subsequent paragraphs.

All of the Cessna 170-B airplanes were equipped with standard aircraft low-frequency radios which were capable of transmitting a maximum of 50 miles and of receiving CAA radio range signals, weather information, and special reports. Several aircraft were equipped with VHF (high frequency) radios that transmitted line-of-sight distances of more than 50 miles. In mountainous terrain, however, the low-frequency radios were able to contact the CAA range stations at lower elevations due to the arc of the radio's transmitting signal. The aircraft equipped with VHF radios climbed to higher elevations for adequate line-of-sight transmission to the CAA range stations. This sometimes entailed a climb of two or three thousand feet to send position reports which were required on the hour and half hour. Although VHF transmission is more static-free than low frequency it is recommended that for similar operations at low elevation in mountainous terrain, the CAA continue to maintain low frequency units as a part of its radio network.



PLATE V. A MAPPING CREW, AND ONE OF THE AIRCRAFT USED IN THE SURVEY.



A mapping crew in full gear prepares to take off. Each crew consists of a pilot, a beetle-damage observer, and two blowdown observers.

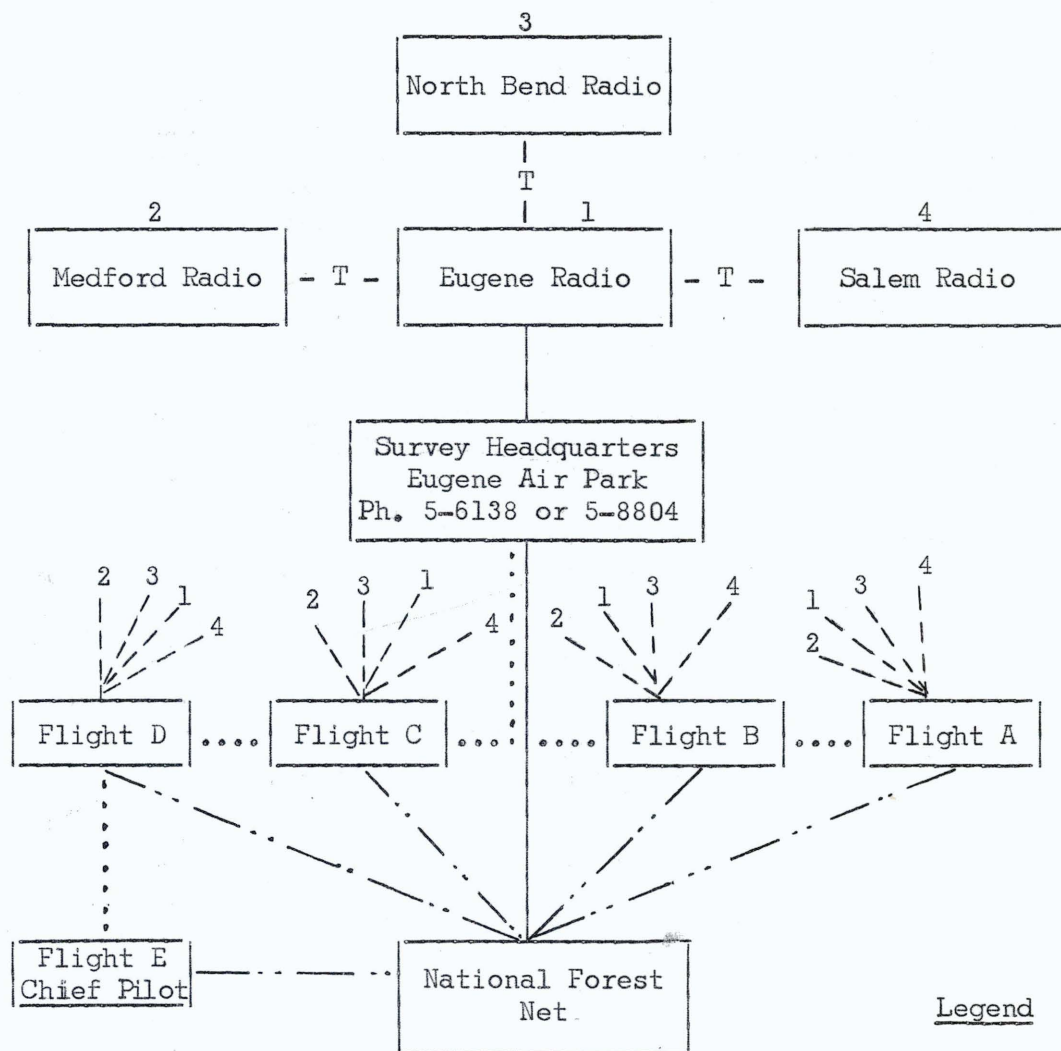


U.S. Bureau of Entomology and Plant Quarantine survey plane during observation flight southwest of Eugene, Oregon. This is the type of plane used for the survey.



# COMMUNICATION NETWORK

Blowdown - Bark Beetle Project - 1952



## Legend

- \_\_\_\_\_ Telephone
- ..... VHF "Unicom"
- - - - Low Freq. or VHF
- T - Teletype
- \_\_\_\_.. F.M. Portable

All Cessna 170-B's with VHF radios were equipped with an additional 122.8 mc "Unicom" frequency crystal both for interplane communication and for direct communication with the 122.8 mc receiving and transmitting unit located at the operations base. This frequency has been set up by the Federal Communications Commission for this type of communication. Thus it was possible for two planes working in near areas to check with one another on their relative positions as well as to transmit position reports to the base when only one plane was in contact with the base. This "buddy" system of planes keeping in touch with each other worked out satisfactorily when both planes were flying about the same height in similar terrain. At times, however, it was necessary for a "buddy" pair to fly above the intervening terrain at certain intervals in order to transmit information to each other regarding their positions.

A third type of radio which was of great value in the high altitude contour flying in the Cascades was the portable type Motorola "Handie-Talkie." These low-frequency fm sets, operating between 30 and 40 mc on the assigned Forest Service frequencies for each national forest, were mounted on each plane. The Handie-Talkie radio with the frequency for the forest to be flown on any particular day placed in the plane and the corresponding antenna, was attached to the wing strut of the airplane. Direct contact could be made with Forest Service lookouts having the same frequency by merely pressing the button on the telephone type transmitter-receiver unit. Lookouts would either relay position reports to the base or file them in case of emergency. Generally one lookout would inform the neighboring lookout of a survey plane approaching into his area. Seldom was a survey airplane out of sight of a lookout or out of touch by radio with one or more lookouts. Both low frequency and VHF transmission on CAA channels are blocked out at times by the deeply dissected terrain and the Handie-Talkie provided a good safety feature to the radio network.

The Civil Aeronautics Administration through its network of powerful range stations was in essentially continuous contact with all aircraft throughout the project area and were most helpful in relaying position reports that could not be transmitted directly to the base of operations. The CAA was notified of all flight plans and was alerted to act promptly on all messages from the survey planes.

The value of the radios, radio facilities, and personnel participating in the communications system on the blowdown - bark-beetle survey cannot be minimized since they were truly the backbone of the safety program.



## Weather.

Special acknowledgment is due the U. S. Weather Bureau, which organized the weather reporting service for the project and provided a special observer. Additional weather information was obtained by contacting State, private, and Forest Service lookouts when needed. This information was transmitted to the base of operations by the radio systems of the various agencies or directly by telephone.

## Mapping Accuracy and Limitations

Aerial sketch mapping should not be regarded as a precise manner of recording the location and amount of damaged timber. Furthermore, the accuracy obtained by sketch-mapping is not always consistent; it may vary for the following reasons: (1) The experience and inherent ability of the observers; (2) the presence or absence of natural or physical features for referencing what is seen from the air; (3) the quality and scale of base maps; (4) location of the damage in respect to position of the aircraft, (5) climatic conditions for viewing and (6) air speed and height of flight of the airplane. However, from ground and aerial checks of mapping on the blowdown-bark-beetle project it was found that patches of blowdown and groups of beetle-killed trees were almost always within one-fourth mile of their true position. It is doubtful if this degree of accuracy could be significantly increased without employing observers on a permanent basis or making a more intensive coverage of the survey area. Small units of area, however, could be covered much more intensively and, by using larger scale maps or aerial photographs for the sketch-mapping, a very accurate job could be obtained.

Weather and smoke were critical items in accurate observation and mapping. If cloud cover exceeded three-tenths, mapping became extremely difficult due to shadows and was discontinued. High, thin overcast conditions, however, were good for mapping since no shadows were cast and the glare of full sunlight was not present. Smoke from forest fires blocked out some areas for a period and were done later. It was found that the period from about 9:30 a.m. to 3:30 p.m. was optimum for mapping at this time of year and all work was restricted to this period.

Mapping of standing beetle-killed trees was generally much easier than mapping the windthrow. On clear days it was not difficult to map beetle-killed groups of trees up to 2 miles away, barring intervening ridges. Windthrow on the other hand could not consistently be picked up for more than a half mile, except with areas of very heavy blowdown on facing slopes.

BLOWDOWN-BARK-BEETLE SURVEY  
Daily Air Operations Schedule

Morning Flight

Flight	Work Area Designation			Crew
	Quadrangle	Block	Flight Lines	
A	Scottsburg - Ivers Pk.	K	25-29	Regular
B	Mt. Hood Z - Estacada NW, NE	J	3	Regular
C	Roseburg SE, NE	W	4-9	Regular
D	Bridal Veil -- Lookout Mtn.	G	1-6	Hudgins, Orr, Robinson, Merrick
E	(Weather hop)			Wear

Remarks: Flights A & C use Umpqua N.F. radios; land at Roseburg for lunch.  
Flights B & D use Mt. Hood N.F. radios; land at Troutdale for lunch.

Afternoon Flight

Flight	Work Area Designation			Crew
	Quadrangle	Block	Flight Lines	
A	Ivers Pk. - Sitkum	J	22-28	Same as A.M.
B	Estacada NW, NE	J	2	Same as A.M.
C	Roseburg SW, NW	J	1-3 50-56	Same as A.M.
D	Hood River SW, NW, NE	G, F	4-5	Same as A.M.
E	(No flight)			

Remarks:



AIRCRAFT FLIGHT CLEARANCE

Blowdown-Beetle Survey  
Eugene, Oregon

DATE Aug. 2 1952      AIRCRAFT NO. 1625D      REPORT NO. D-29

PILOT Hudgins      AIRCRAFT 170-B

BASE OF OPERATION Eugene, Ore.

FLIGHT AUTHORIZED BY Olin

PURPOSE OF FLIGHT Sketch mapping

PASSENGERS Spada - Barber - Wright

ROUTE Direct to Line 3 area Q; return to Eugene

DESTINATION Eugene, Ore.      TIME OFF 13:36 (ATO)

ESTIMATED TIME OF ARRIVAL 16:30 (15:14 ATA)

TIME CLEARANCE CLOSED 15:15

SIG. PILOT Hudgins (D.O.)      SIG. OPERATIONS OFFICER D. D. Olin

CLEARANCE CLOSED BY Daniel D. Olin

Department of Commerce - Civil Aeronautics Administration  
AIRCRAFT FLIGHT CONTACT RECORD

Station: Beetle Base  
Date: August 2, 1952

Aircraft Identification	VFR	IFR	Position	Time	Altitude	From	Route To	ETOV	Time of Contact	TOD ARTC	Initials
1. 94D			6 mi. W. Tidbits Mtn.	11:18							
Remarks Going to Line 4											
2. 25D			Headwaters Deer Cr.	11:26							
Remarks Near Fawn Rock L.O.											
3. 94D				11:56							
Remarks Completed Line 4, returning to base											
4. 25D			10 mi. S. Eugene	12:01							
Remarks ETA 12:08											
5. 25D				13:43							
Remarks Going to Block Q, Line 3											
6. 25D				14:19							
Remarks Starting Line 4, Block Q											
7.											
Remarks											
8.											
Remarks											



DAILY AIRCRAFT FLIGHT REPORT  
Blowdown-Beetle Survey  
Eugene, Oregon

Date July 23 1952  
Pilot J. Harrell

CAA No. 9153A Report No. A-34  
Airplane Cessna 170-B

DESCRIPTION OF FLIGHT MISSION

No.	FROM	TO	Flight Time			Character of Flight	
			Takeoff	Landing	Total	Code*	Forest
1	Eugene	North Bend	9:10	12:05	2:55	SM	Roman Nose Quad.
2	North Bend	Eugene	12:52	4:13	3:21	SM	" " "
3					6:16	D.O.	
4							

COST OF OPERATIONS

No.	GASOLINE		OIL		REPAIR COSTS		STORAGE CHARGE	Visibility and Weather
	Gals.	Price	Qts.	Price	Parts	Labor		
1	22.4	6.94	1	40				Thin, scattered
2	24.1	7.47	1	40				Clear
3								
4								

Remarks:

Passengers: Lanz, Stevens, Spada

Discrepancies on airplane: None

Miscellaneous: Line checked ok - D.G.

\*SM = Sketch mapping, F = Ferry, P = Photography, R = Radio check, T = Test hop, TR = Training.

Certified correct by: Daniel D. Olin  
Air Operations Officer

Date July 18, 1952  
Pilot LamoureauxCAA No. 1625E  
Airplane Cessna 170BDAILY AIRCRAFT INSPECTION REPORT  
Blowdown-Bark-Beetle Survey  
Eugene, Oregon

Daily line inspection is to be made on each airplane after each day of flying on this survey. Any discrepancies reported on the pilot's daily flight sheet, or found on the daily inspection will be noted, checked, and promptly corrected. All major discrepancies which would mean delays in remedying or entail grounding of the airplane will be brought to the attention of the AOO. Minor discrepancies will be checked and corrected as indicated on this inspection form.

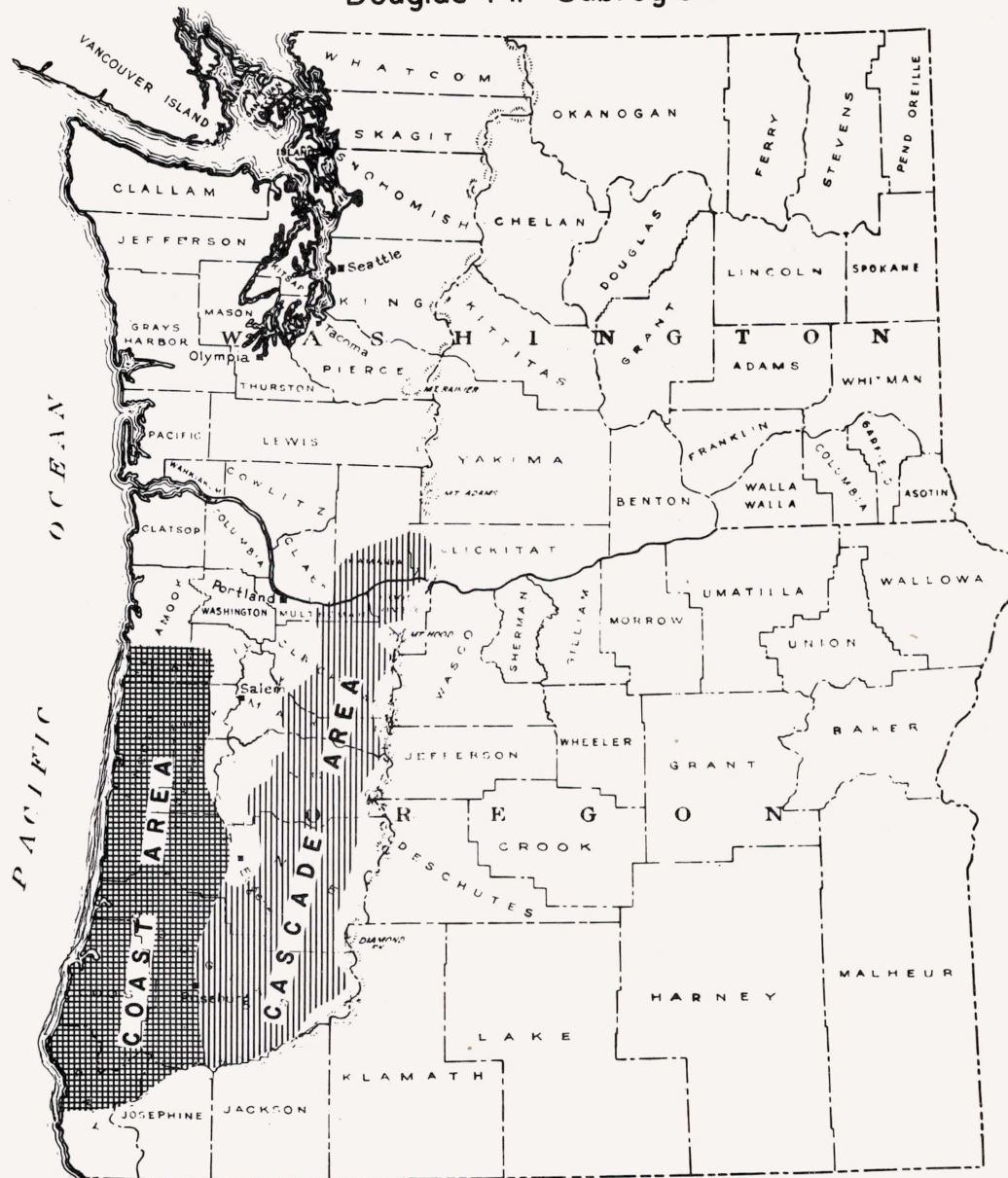
Airplane Check Items	Okay Needs repair	Repair made--- see memo
1. <u>Engine and Nacelle Group</u>		
a. Propeller. Check for cracks, nicks or damage.		
b. Electrical.		
Voltage regulator.		
Generator for oil leaks & housing secured to frame.		
Starter - housing secured to mounting frame.		
c. Engine Controls		
Throttle control.		
Carburetor heat control.		
d. Power Plant.		
Cowling for damage & security.		
Carburetor heat - clear & unobstructed.		
Oil filter mounting bracket secure.		
2. <u>Wing Group</u> (wings, vertical & horiz. stabilizer).		
a. All surfaces for tears, abrasions, defects.		
b. All moveable surfaces (aileron, flaps) for		
damage and obvious defects.		
3. <u>Fuselage Group</u>		
a. General condition; windows & windshield clear.		
4. <u>Flight Control Mechanism</u>		
a. Function & normal operation of rudder, flaps,		
elevator & aileron from cockpit.		
b. Inspect bearings & hinges of above for		
looseness or cracks.		
5. <u>Tail Gear</u> - proper functioning.		
6. <u>Landing Gear, Wheels &amp; Brakes</u>		
a. Fairings & struts for gen. cond. & defects.		
b. Tires--proper inflation & cond. (20-21# pressure).		
c. Wheel covers tight.		
d. Brake and parking brake.		
e. Hydraulic lines for leaks.	x	
7. <u>Fuel System</u>		
a. Drain fuel strainer.		
b. Oil level full.		
c. Fuel level full.		
d. Lines from outside for oil or gas leaks.		

Remarks:

Line inspection, 1625D okA&ED. Green, 1052428Signature



MAP I  
AREAS MAPPED: 1952 BLOWDOWN-BARKBEETLE SURVEY  
Douglas-Fir Subregion



**LEGEND**



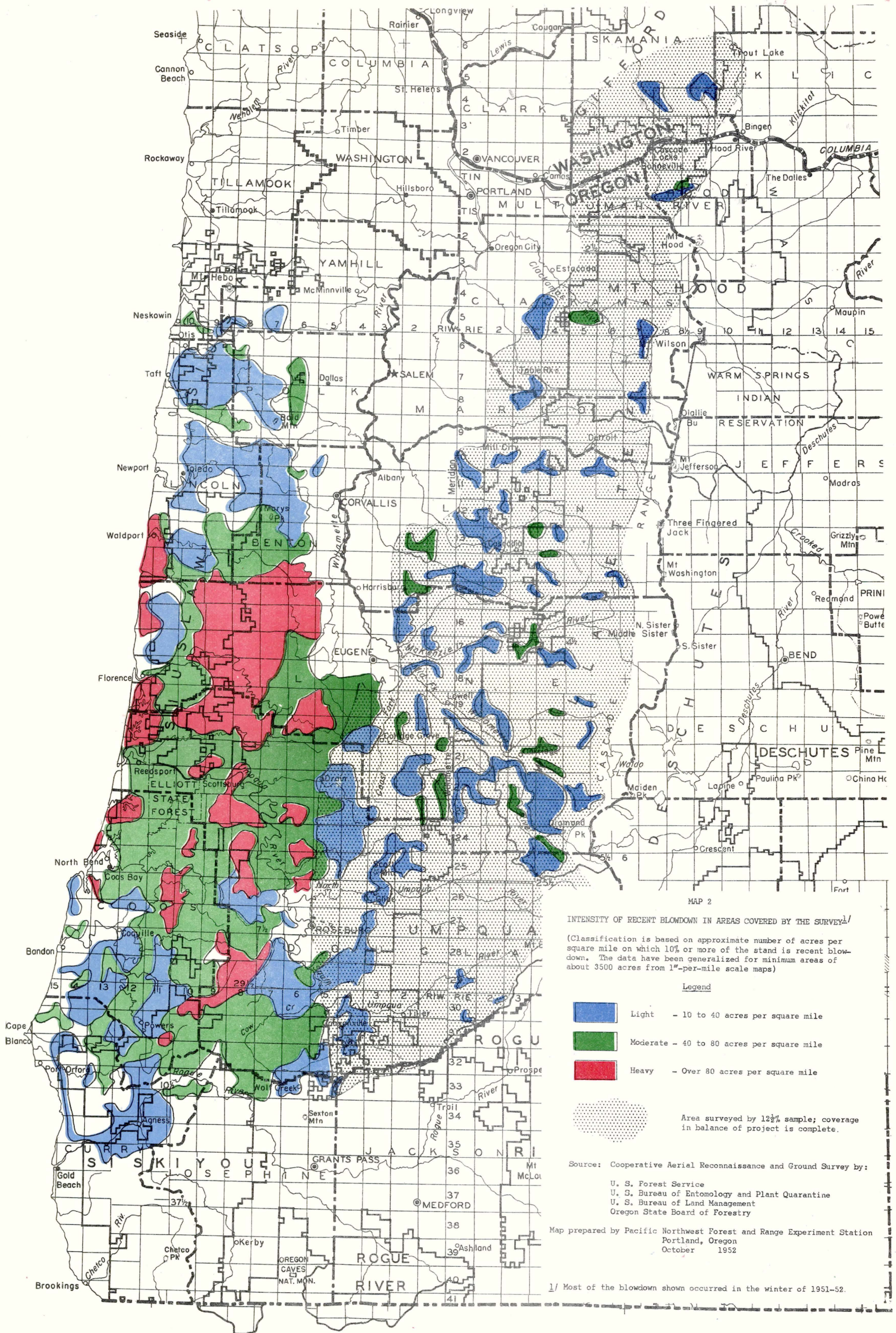
Area mapped 100 percent for blowdown and beetle-killed timber (flight lines 1 mile apart)



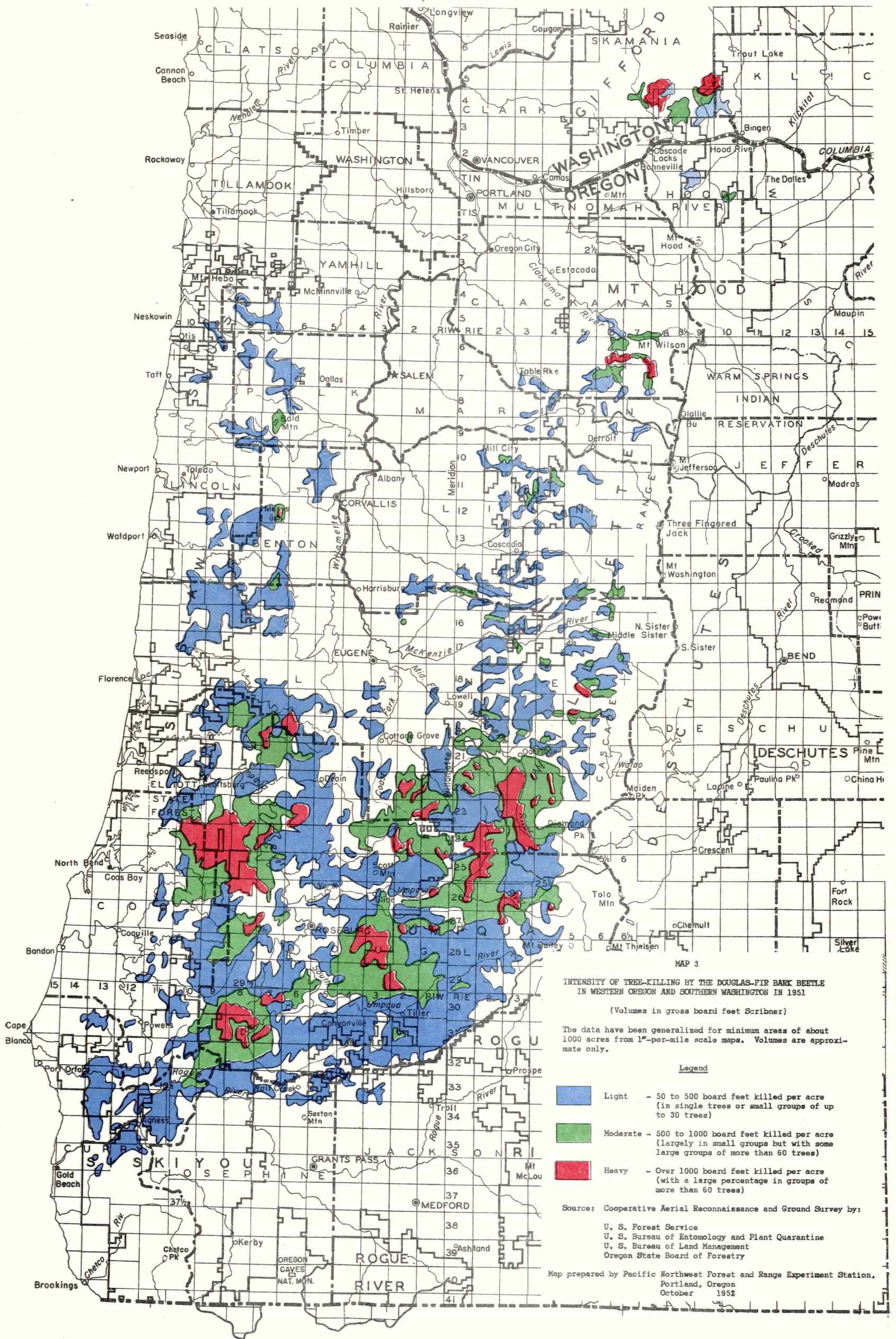
Area mapped 100 percent for beetle-killed timber, 12 1/2 percent for blowdown (flight lines 2 miles apart)

Pacific N. W. Forest & Range Experiment Station  
Portland, Oregon  
October 15, 1952









MAP 3  
INTENSITY OF TREE-KILLING BY THE DOUGLAS-FIR BARK BEETLE  
IN WESTERN OREGON AND SOUTHERN WASHINGTON IN 1951

(Volumes in gross board feet Scribner)

The data have been generalized for minimum areas of about 1000 acres from 1"-per-mile scale maps. Volumes are approximate only.

Legend

- Light - 50 to 500 board feet killed per acre (in single trees or small groups of up to 30 trees)
- Moderate - 500 to 1000 board feet killed per acre (largely in small groups but with some large groups of more than 60 trees)
- Heavy - Over 1000 board feet killed per acre (with a large percentage in groups of more than 60 trees)

Source: Cooperative Aerial Reconnaissance and Ground Survey by:

U. S. Forest Service  
U. S. Bureau of Entomology and Plant Quarantine  
U. S. Bureau of Land Management  
Oregon State Board of Forestry

Map prepared by Pacific Northwest Forest and Range Experiment Station,  
Portland, Oregon  
October 1952



